

CENTENARY HISTORY
OF THE
LIVERPOOL & MANCHESTER
RAILWAY

DENDY MARSHALL



Centenary History of the
Liverpool and Manchester Railway

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RAILWAYS

THE RESISTANCE OF EXPRESS TRAINS.

[*The Railway Engineer, London; 1925*]

TWO ESSAYS IN EARLY LOCOMOTIVE HISTORY.

[*The Locomotive Publishing Co., Ltd.; 1928*]

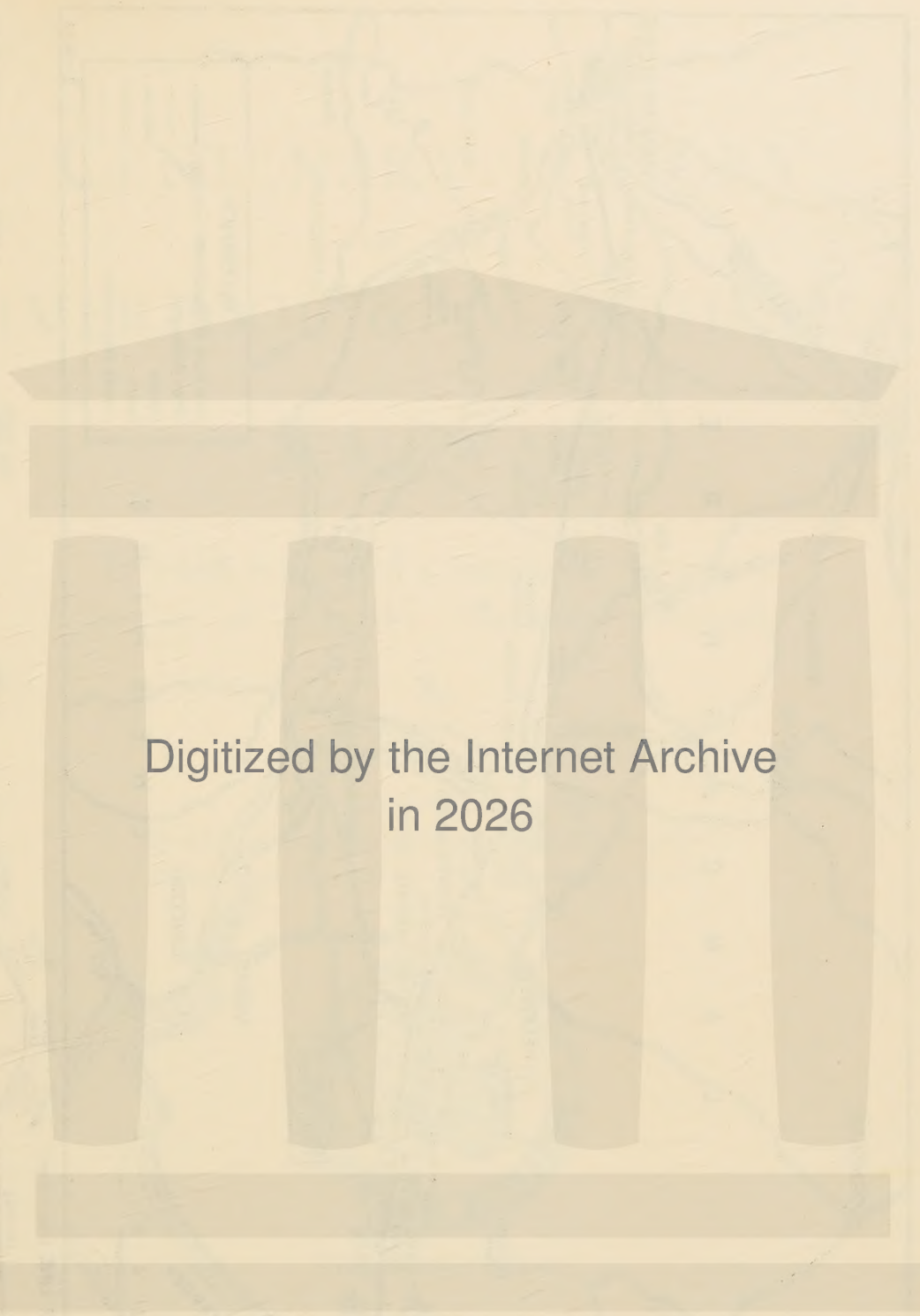
POST OFFICE

THE BRITISH POST OFFICE FROM ITS BEGINNINGS TO THE END OF 1925.

[*Oxford University Press; 1926*]

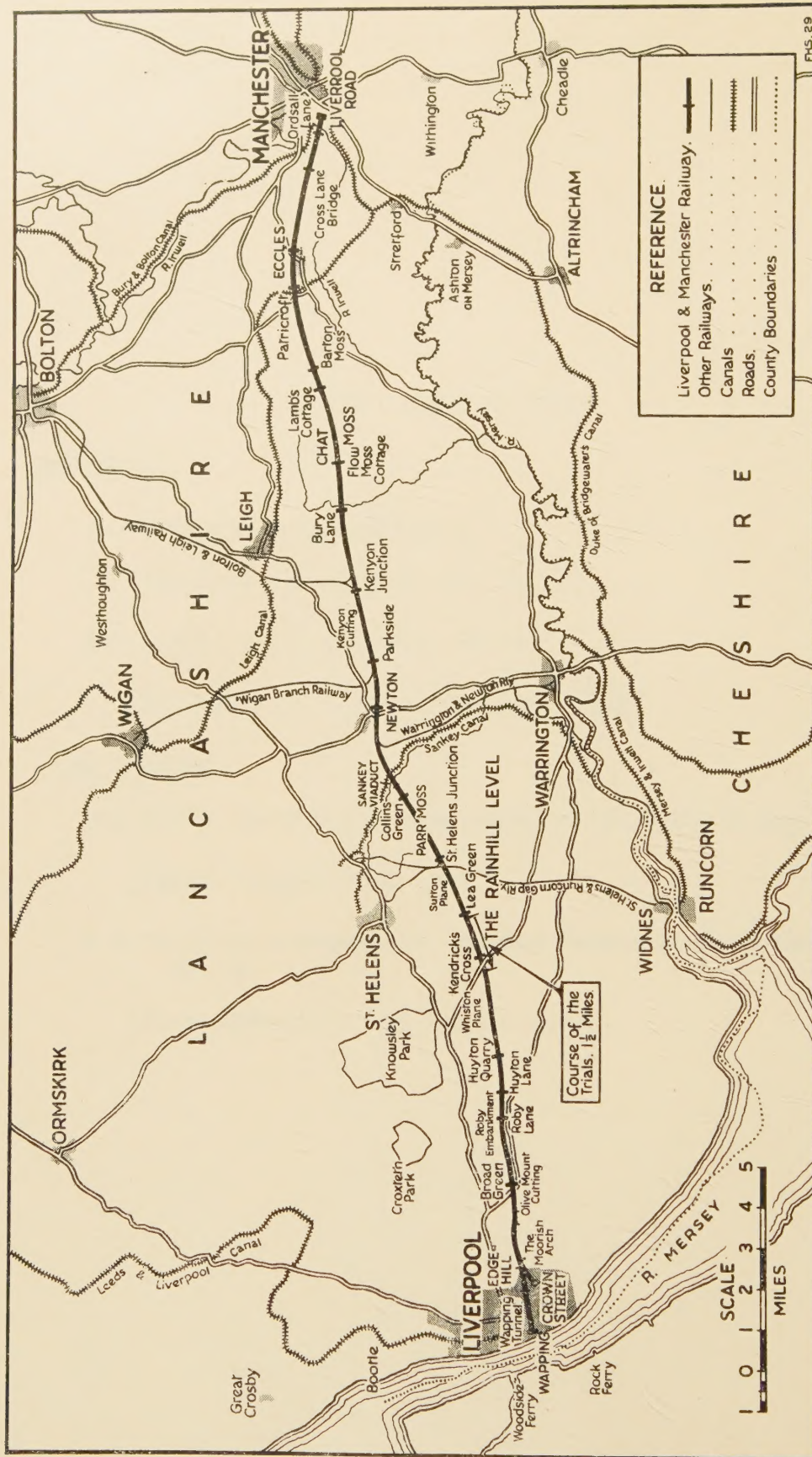
A STUDY OF THE LINE-ENGRAVED TWOPENCE POSTAGE STAMPS OF GREAT
BRITAIN.

[*Harris Publications, Ltd., London; 1929*]



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CENTENARY HISTORY OF THE LIVERPOOL & MANCHESTER RAILWAY

To which is appended a transcript of the relevant
portions of Rastrick's 'Rainhill' Notebook

By

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THE COMPANY'S SEAL.

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Preface

LEST those who are unversed in the history of Railways, remembering the Centenary celebrations held in 1925 to commemorate the opening of the Stockton and Darlington Railway, should be disposed to think that the occasion which has called forth this book is relatively unimportant, it will be well to draw attention to the very different characters of that line and the Liverpool and Manchester.

The Stockton and Darlington was the first public railway to use locomotives, as its predecessors which had done so had merely been private lines for conveying the coals and materials of particular collieries. It was also the first railway constructed with the deliberate intention of employing them; though far from exclusively, since horses were also used, side by side with, or perhaps one should rather say, in between, the engines. For a number of years passengers were drawn by horses, in stage-coach bodies mounted on railway wheels, run by contractors who were bought out by the railway company in 1833, after which it carried them on its own account¹. It is true that for a short time they had taken passengers in their own and only coach, the 'Experiment'—which is very badly libelled in Smiles' illustration—but they did not care about doing so, and let the coach to a contractor on April 1st, 1826².

Such was the passenger traffic on the Stockton and Darlington Railway during the first few years.

¹ Tomlinson's 'North Eastern Railway,' p. 364.

² Ibid. p. 124.

PREFACE.

It was the Liverpool and Manchester Railway which was the first railway, as we understand the term, in the world. Its opening, on September 15th, 1830, brought in a new era, and wrought a tremendous social revolution. It is true that it was ante-dated by the Canterbury and Whitstable Railway, opened on May 3rd, 1830; a very small affair, with only one locomotive, and worked mainly by ropes; also by the Baltimore and Ohio Railway, a fifteen mile section of which was opened on May 22nd of the same year; but the former cannot by the wildest stretch of imagination be described as epoch-making, and the latter, while of great interest as the commencement of a mighty undertaking, did not at that time possess any locomotives capable of working it, and used horses or mules for several years.

The Liverpool and Manchester Railway showed the world what could be done, and led to the greatest change in the habits of mankind that has ever come about otherwise than by a process of slow and gradual evolution.

The following account is based on a careful study of every work which is included in the bibliography. References are given for all the more important statements, except such as either are unlikely ever to be questioned, or can be quite easily verified. The difference between a history written long after the events that is properly documented and one that is not, is very much like that between a live lion and one stuffed with straw.

Most of the illustrations are reproduced from originals in the author's collection, but he is indebted to Messrs. Robert Stephenson and Co. for the loan of about twenty blocks from 'A Century of Locomotive Building,' which is one of the finest books on the locomotive ever produced.

The author has to thank many kind friends who have helped to clear up obscure points, more particularly Messrs. E. A. Forward, A. C. W. Lowe, J. G. H. Warren, B. Welbourn and C. Williams, and owes a special debt of gratitude to Mr. O. Glynn Roberts of the London, Midland and Scottish Railway Company, for supplying a large amount of interesting information extracted from the original minutes of the Directors and other official sources. Some of the details relating to locomotives were received from the late Mr. E. L. Ahrons, whose able advice and wide knowledge have often been sadly missed in writing this work.

CONTENTS

	PAGE
List of Plates	ix
Chapter I A short description of Liverpool and Manchester and their means of communication down to 1825	1
II The State of Railway Development in 1825	5
III The Preliminaries	7
IV The Makers of the Line	16
V The Construction	22
VI The Rainhill Trials	35
VII The Opening Day	58
VIII The Line as a going concern	64
IX The Locomotives: the regular stock	73
X The Locomotives: supplementary	102
XI The Builders of the Engines	110
XII Branch and Connecting Railways	114
XIII The early views of the Line	127
XIV A Bibliography	140
XV Commemorative medals, and miscellaneous objects of interest	152
Appendix; Rastrick's ' Rainhill ' Notebook	159
Index	189

THE PLATES.

	Map of the Railway	...	...	...	<i>Frontispiece.</i>	
I	George Stephenson	...	...	...	<i>To face page</i>	16
II	Robert Stephenson	...	...	...	...	18
III	View of the Railway across Chat Moss	...	...	...	...	22
IV	Excavation of Olive Mount (4 miles from Liverpool)	...	...	...	...	23
V	The Tunnel	...	...	...	...	24
VI	Rainhill Bridge	...	...	...	...	25
VII	Viaduct across the Sankey Valley	...	...	...	...	26
VIII	Moorish Arch, looking from the Tunnel	...	...	...	...	27
IX	Entrance of the Railway at Edgehill, Liverpool	...	...	...	...	28
X	Near Liverpool, looking towards Manchester	...	...	...	...	29
XI	Entrance into Manchester across Water Street	...	...	...	...	30
XII	Warehouses, &c., at the end of the Tunnel towards Wapping	...	...	...	...	31
XIII	Olive Mount	...	...	...	...	32
XIV	View of the L. & M. Railway where it crosses the Bridgewater Canal	...	...	...	...	33
XV	Nicholas Wood	...	...	...	...	51
XVI	Parkside (The Station where Mr. Huskisson fell)	...	...	...	...	62
XVII	Railway Office, Liverpool	...	...	...	...	64
XVIII	Coaches, etc., employed on the Railway	...	...	...	...	65
XIX	A first class carriage, and ' Rocket No. II '	...	...	...	...	66
XX	Travelling on the Liverpool and Manchester Railway	...	...	...	...	68
XXI	New grand entrance at Lime Street, etc.	...	...	...	...	71
XXII	Tickets, etc.	...	...	...	...	72
XXIII	The ' Phoenix ' locomotive and carriage	...	...	...	...	82
XXIV	The ' Intersection ' Bridge	...	...	...	...	116
XXV	Commemorative Medals	...	...	...	...	152
XXVI	Medals, etc.	...	...	...	...	153
XXVII	Jugs, etc.	...	...	...	...	154
XXVIII	Mug and plate	...	...	...	...	155

Chapter I

A SHORT DESCRIPTION OF LIVERPOOL AND MANCHESTER, AND THEIR MEANS OF COMMUNICATION IN 1825.

AT the beginning of the eighteenth century, Liverpool was the third port of the Kingdom, its principal trade being with the West Indies, to which was added the tobacco trade with Virginia. There was also considerable traffic with the continent, in rivalry with Hull. About the middle of the century, a curious trade sprang up, which, although one of the chief sources of its prosperity for a great many years, is not one which can be a source of much pride. It consisted of a peculiar system of triangular voyages; firstly from Liverpool to West Africa with cheap Manchester goods, bad muskets, glass beads and inferior spirits. These commodities were exchanged for a full cargo of 'prime negroes branded as per margin¹.' After a rapid run on the trade winds, they were disposed of at high prices to the West India planters, and the proceeds invested in sugar, tobacco, rum and cotton for the homeward journey. In 1813 the monopoly of the East India Company came to an end, and Liverpool began trading with India, which was not only an excellent market for Lancashire cotton goods, but also a fresh source of supply for the raw material.

Meanwhile, Manchester was also advancing rapidly in prosperity. Between the years 1780 and 1824, while the population of Liverpool went up from 26,000 to 125,000, that of Manchester increased from 22,000 to 160,000. Thanks to Hargreaves, Arkwright, Crompton and others, the

¹ In the eleven years 1783 to 1793, Liverpool slaving ships carried 303,787 slaves from Africa to the West Indies, and sold them for £15,186,850. 'A History of Liverpool,' by Ramsay Muir, 1907.

spinning industry progressed by leaps and bounds, and then, to crown all, came the steam engine.

Manchester had not so exciting a past as that of Liverpool. It had pursued its course more quietly, weaving and spinning; save for an occasional riot or so, in which the new-fangled machinery suffered badly; until it eventually became the great cotton factory of the world. Besides this, it was the centre of collection and distribution for goods made not only in Lancashire, but also Yorkshire; and the traffic in raw materials inwards, and manufactured articles outwards, between it and the Port of Liverpool was enormous.

Down to the end of the eighteenth century the goods were chiefly carried on packhorses. In 1788 no less than seventy of them started daily for Manchester from one Liverpool inn alone.

The first attempts to improve the communication by water had been made in 1720, when the Mersey and Irwell were rendered navigable as far as Manchester. This undertaking was generally known as the Old Quay Company.

Though it did not actually help the intercommunication of the two towns, mention may here be made of the 'Sankey Navigation,' which was opened in 1757 for connecting the St. Helens coalfield with the Mersey. This was the first real canal made in England. Previously the 'navigations,' as they were called, merely consisted in improving the existing rivers, but in this case Brindley made an independent channel, avoiding the irregularities of the natural stream, but utilising it to feed the canal, and to carry off superfluous water. Horse-traffic was prohibited, and, when the barges were unable to sail, they were tugged along by bands of men, six or eight abreast.

On the last day of 1772 the celebrated Bridgewater Canal was opened, forming a communication between Manchester and Runcorn, the last stage of the journey to Liverpool involving sixteen miles in the Mersey Estuary.

In 1770 an Act had been obtained for the Leeds and Liverpool Canal, which was also a waterway to Manchester, but it was not completed until 1819, and even then does not seem to have taken a great deal of the traffic.

LIVERPOOL AND MANCHESTER.

The disadvantages of the canals were that they were liable to be obstructed by drought in summer, and ice in winter; and the passage from Runcorn to Liverpool was difficult and dangerous in bad weather; in fact none too easy at any time, owing to the numerous sandbanks. And there were always the tides to be taken into consideration. Apart from all this, the traffic had grown so enormously that it was physically impossible to deal with it in a reasonable manner. A single order for timber was sometimes conveyed in dribblets extending over months, and the same was the case with cotton, 160,000,000 pounds of which were taken from Liverpool to Manchester in 1824.

Goods sometimes came from America to Liverpool in 21 days, and stayed on the wharfs for weeks before they could be taken on. In spite of the unsatisfactory nature of their service, the canal proprietors took full advantage of their position, and imposed excessive dues; enriching themselves to such an extent that dividends of fifty per cent. were paid, and shares soared up to nearly twenty times their original value.

In 1797 William Jessop had suggested that a tramroad, to be worked by horses, should be laid down, and surveyed a route. The following year Benjamin Outram made another survey for a line, but nothing came of either proposal.

Thomas Gray, in his 'Observations on a General Iron Railway,' first published in 1820, advocated beginning with one between Liverpool and Manchester; but the credit for the earliest practical scheme is due to William James, whose proposals will be returned to in a succeeding chapter.

The chief part of the opposition was directed against the railway *per se*, with the well known arguments about preventing the cows from giving milk, and the hens from laying, and so forth; but there were also some people who had the temerity to take the line that nothing further in the way of communication was required. A double sheet was issued, headed 'The Liverpool and Manchester Railway. A few Plain Facts.' It was arranged in parallel columns, the left containing seven 'Statements,' which were put forward as coming from the advocates of the railway; the right, headed 'Facts,' being replies. The first is given as a specimen:

LIVERPOOL AND MANCHESTER.

1. That the distance between Liverpool and Manchester by the Mersey and Irwell Navigation is upwards of 50 miles—by the rail-road only 33.

The Mersey and Irwell is at present only 42 miles, and will be shortened nearly 3 miles by two new cuts which the Company are about to make immediately, having actually contracted for the land for this purpose.

The author does not know the true distance by the route in question, but that by the Bridgewater Canal was undoubtedly 48 miles. It looks as if the canal company had begun to take alarm. This is the final paragraph:

The preceding facts will, it is hoped, satisfy the public that there is not the least necessity for a fourth communication between Liverpool and Manchester. That the advantages held out by means of a Railway are fallacious, and not warranted by any one circumstance. Neither in speed, cheapness, nor accommodation can a Railway, even with locomotive engines, compete with water conveyance. The attention of the Legislature is most particularly requested to one simple fact, viz., that whilst the promoters of the Bill allege the want of accommodation, they actually propose to take from the Mersey and Irwell Navigation Company *two of their wharfs* which have been appropriated to the public for twenty years past, *and to use them for their own purposes*. Surely such an Act of monstrous injustice as to take from the Company a part of their legal possessions, and give them to a rival establishment, will not receive the sanction of the Legislature. The parties have included in their Schedule to the Bill, the *towing path* of the Navigation in one instance, and the *River Irwell* and the bed thereof in another.



Chapter II

THE STATE OF RAILWAY DEVELOPMENT IN 1825.

BY this time nearly every place where there was a mine had some sort of railway, the more important ones, which had been constructed under Acts of Parliament, numbering about 22¹. But of course those laid down on private property, as many of the colliery lines were, did not need an Act.

Locomotion was effected in four ways: (1) horses, (2) self-acting inclines (in these the loads were all down hill, and gravity supplied the power), (3) stationary engines hauling the vehicles by means of ropes, (4) locomotives.

Of the latter, at least thirty had been built for railway work in England; two in Germany, which would not go; and one, a mere model, in the United States. Those actually doing useful work in 1825 were as follows; eighteen in all:

Four at the Middleton Colliery, near Leeds; Blenkinsop and Murray's rackrail engines, built 1812 and 1813.

Three at Wylam Colliery, near Newcastle; Hedley's 'Puffing Billy' type, for plate rails; built in 1813. Two of them, probably much restored and altered at various times, still survive, one at South Kensington, and one at Edinburgh.

Four at Killingworth Colliery, also near Newcastle. These were for 'edge-rails,' that is to say the modern system, with flanges on the wheels; built by Stephenson at various times from 1814 to 1821.

¹ Lewin's 'Early British Railways,' 1925, Chapters I and II.

RAILWAYS IN 1825.

Five at Hetton Colliery, near Sunderland; also by Stephenson, supplied in 1822.

Two on the Stockton and Darlington Railway; constructed in 1825, by the same builder as the last.

In some places to which engines had been supplied, they had been discontinued, owing to their unsatisfactory working. The fate of the locomotive was hanging in the balance; no-one, except a few enthusiasts, believing that it had 'come to stay.' In fact, since 1814, not one had been built, so far as is known, by anyone except Stephenson. Not only hampered by its own crudity and imperfections, due perhaps even more to lack of the skill and facilities required for manufacturing it, than to poverty of design, its chief obstacle lay in the track, which was far too weak to carry it, and continually broke under the strain. The usual rate of progress was not much more than a walking pace, sometimes not even that, and it had to meet all the same kind of opposition that the motor car encountered, seventy years later.

Even some of those who had been sufficiently enterprising to take the plunge and adopt it as a means of haulage, were inclined to waver in their faith, and wonder whether horses were not better after all. Edward Pease is quoted as having written to William James on February 4th, 1826, speaking of the Stockton and Darlington Railway, 'they have placed locomotive engines on the line for the haulage of coals (only), before it is either creditable to them, or of advantage to the Company².'

As for the unbelievers, they scoffed, and rejoiced when a boiler burst, which happened once or twice; and did not hesitate to invent the most absurd stories about the appalling effects which came about where the engines were used; these being all the more easily credited, because comparatively few people had had the opportunity of seeing them and forming their own judgment.

Readers who are inclined to seek further information on the subject of the beginnings of the railway engine, will find a detailed history of the first hundred in the author's 'Two Essays in Early Locomotive History,' published in 1928.

² 'The Two James's and the Two Stephensons,' p. 47.

Chapter III

THE PRELIMINARIES.

AS has been stated in the first chapter, although the matter had been 'in the air' for some years, it is to William James that the credit is due for setting the ball rolling which was kept on the move, with one or two interruptions, until the goal was attained.

Born in 1771, he took up the business of land agency, eventually becoming the proprietor of a number of collieries, and the manager of others. Few men have ever had so many irons in the fire, and it was probably only due to their multiplicity that he came to grief. If this most remarkable man had concentrated on a quarter of their number, he might have occupied a very different place in the roll of fame.

An account of his life will be found in a little book, now of some rarity, bearing the uncouth title 'The Two James's and the Two Stephensons,' by E.M.S.P.; published in 1861. It was written by his daughter, Mrs Paine, with the object of trying to establish his claim to the title of the 'Father of Railways.' She complains that Smiles, in his 'Lives of George and Robert Stephenson,' does not do adequate justice to the part her father played in the early stages of the undertaking, which is to some extent true, and attempts to show that George Stephenson owed his position almost entirely to James, and was guilty of base ingratitude to him, all of which is quite without foundation. It is insinuated, rather than directly stated, that Stephenson was indebted to James for his introduction to Edward Pease¹, but from the Diaries of the latter it appears that Stephenson, on the occasion of his first

¹ P. 46; again, p. 54.

WILLIAM JAMES.

visit to Pease with Nicholas Wood in 1821, was furnished with a letter from 'Mr. Lambert, the manager of Killingworth².'

It is also suggested in one place³, and stated in another⁴, that Stephenson owed his appointment as engineer to the Liverpool and Manchester line to



James; but as the latter was in prison for debt at the time, namely May, 1824, and moreover, seems to have strongly disapproved of the appointment, this is hardly likely.

² 'Diaries,' p. 86. See also Tomlinson's 'History of the North-Eastern Railway,' p. 72.

³ P. 54.

⁴ P. 57.

THE FIRST SURVEY.

On the other hand, one would gather from Smiles that James obtained the idea from Joseph Sandars, who is also violently attacked by Mrs. Paine, but it was far more probably the other way about, as stated by Booth in his 'Account of the Liverpool and Manchester Railway⁵.'

As early as the beginning of the nineteenth century James had projected a great many railways, quite a number of which were constructed, chiefly, but not entirely, in connexion with the mines in which he was interested, and the estates under his supervision. About the year 1808 he put forward a proposal for a 'General Railroad Company' with a capital of a million pounds; also one for a tunnel under the Thames. By 1822 he was advocating the use of locomotives, and in the next year pointing out the possibilities of profit to be derived from passenger traffic, in both of which ideas he was well in advance of the times.

In 1821 he drew up a plan, based on a preliminary survey, for a 'Line of Engine Railroad from Liverpool to Manchester,' in which he succeeded in interesting Joseph Sandars, a Liverpool merchant, who found money for surveying purposes, and became one of the most active promoters of the line, subsequently (1824) publishing a pamphlet in its favour, which will be referred to again later.

The first survey was very imperfect, and a second was made in 1822, with the assistance of Robert Stephenson. All the surveys were conducted in circumstances of great difficulty, in the teeth of strenuous opposition on the part of the owners and occupiers of the land. Every gamekeeper was on the alert to exclude the engineers, and sometimes the situation developed as far as blows. That both sides had something to complain of is indicated in a question asked of George Stephenson by Counsel during the Parliamentary enquiry, as follows: 'Do you suppose it a likely thing to obtain leave from any gentleman to survey his land, when he knows that your men had gone upon his land to take levels without his leave, and he himself found them going through the corn and through the gardens of his tenants, and trampling down the strawberry beds which they were cultivating for the Liverpool market?' The rather naive answer was, 'I have found it sometimes very difficult to get through places of that kind!'

⁵ P. 3, first edition; p 5, second.

To return to James; owing to ill-health and financial embarrassments, he became incapable of proceeding farther with the matter, and in May, 1824, the Committee which had been established to carry out the project appointed George Stephenson as engineer. The author has a copy of a 'Memorial of Mrs. Elizabeth Mudie,' laying her case before the public, and asking for pecuniary aid; probably issued about 1840. It sets forth that she was the sister of the late William James; the first Projector of the Railway System; that owing to turning his attention from his profession to the promotion of railways and expending his resources on surveying them and bringing them before the public, his fortune of £150,000 became greatly involved, and he was declared bankrupt. She submits 'that the system of railways, which her brother was the main instrument in bringing to bear, has been attended with vast public benefit and great pecuniary gain to the undertakers of them; but in which his fortune was seriously impaired, his health injured, and her own provision and prospects destroyed.'

If this strongly worded description of the part played by James in the introduction of railways merely rested on the statement of a relative who was asking for money, one would attach little importance to it. But it is followed by a 'Recommendation,' supporting Mrs. Mudie's case, and signed by fourteen influential names, including those of James Walker, Robert Stephenson, Joseph Locke and I. K. Brunel. From which we may infer that his name has hardly received the recognition to which it is entitled.

Sandars' pamphlet was the first shot fired in the new campaign. Addressed 'To the Members of both Houses of Parliament, and to the Merchants, Manufacturers and Others, interested in the Conveyance of Goods between Liverpool and Manchester,' its title forms a fairly adequate description of the contents: 'A Letter on the subject of the proposed Rail Road between Liverpool and Manchester, pointing out the necessity for its adoption and the advantages it offers to the public, with an *Exposure of the exorbitant and unjust Charges of the Water Carriers.*'

It stated that it had now been ascertained that the power of the steam engine could be applied to the 'propelling or dragging of goods and passengers on a Rail-road,' and that passengers would be able 'to travel between Liverpool and Manchester at 10 or 12 miles an hour at one-half the price they pay now.'

THE FIRST PROSPECTUS.

A Company was then formed, under the chairmanship of Charles Lawrence, the Mayor of Liverpool, and the first prospectus was issued on October 29th, 1824. It is given in full in Booth's 'Account.' The estimated expense was £400,000. The advantages to be obtained by the carriage of

Estimate of the Expense of the proposed Rail Road from the Port of Liverpool to the Town of Manchester

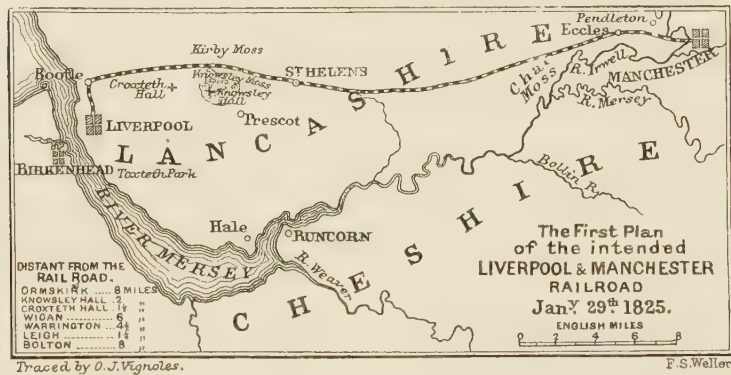
Forming 12 miles of road	599 2 6
Drainage 12 miles	100 0 0
Stone 12 miles at 15 each	1800 0 0
Chert 12 miles at 10 each	1200 0 0
Gravel 12 miles at 35 lb. in each ft. 34 miles	617 10 0
Laying 12 miles of Road for 34 miles at 15 each	1440 0 0
Fencing the Road	529 8 0
Gates 400 at 15 each	600 0 0
Hedges 12 miles at 10 each	1200 0 0
Locomotive Engines 20 at 60 each	1200 0 0
Coal 12 miles at 10 each	1200 0 0
Carriage 12 miles at 10 each	1200 0 0
Warehouses & Office	2500 0 0
Sand	100000 0 0
Survey & cost of Parliament	10000 0 0
Contingencies during the performance of the Work	25000 0 0
Total	400000 0 0

Geo. Stephenson Engineer
January 5th 1825

various classes of goods were carefully enumerated, and there was a casual mention of passengers. The question of employing locomotives was kept entirely in the background, the word only being mentioned once, and then merely in the course of conveying the information that the Emperor of Russia had made an application for models of them. At that time, however, it is

THE PARLIAMENTARY CAMPAIGN.

evident that, in consequence of a visit by a deputation of the committee to Killingworth, they had every intention of using them, because, in the proceedings before the Parliamentary Committee in the following year, a great deal of evidence was given on the subject, and Counsel for the promoters said in his opening speech, 'Locomotive engines we shall have, and horses we may employ if we think fit, but we shall not have to supply one single fixed steam engine from one end of the line to the other.' Evidently the early surveys went through more level country than the line finally adopted. The line then proposed had been surveyed by George Stephenson. Owing to a large extent to the difficulties thrown in his way, it was shown to be very inaccurate by the opponents, whose engineers of course had the advantage of being made welcome, and allowed to go wherever they liked.



Application was made to Parliament early in 1825. The fight was a strenuous one, the proceedings in Committee lasting more than three months, but the Bill was lost, the opposition being too strong. However, the promoters were not daunted, and determined to try again the following session, which they did after introducing certain modifications which avoided some of the worst of the difficulties they had encountered.

In the place of George Stephenson they appointed George and John Rennie as engineers, who had an established reputation. A new line, passing considerably to the south of the former route, was surveyed by Charles Vignoles, who was made resident engineer under the Rennies.

THE SECOND PROSPECTUS.

It avoided the properties of its most powerful opponents as far as possible, and entered Liverpool by a tunnel and steep gradients, so as to obviate the necessity for crossing streets, which had been strongly objected to. Manchester was not to be invaded at all, the line terminating at Salford, without crossing the Irwell. The opposition of the Bridgewater Trustees was overcome, the Marquis of Stafford being induced to take a thousand shares, and being allowed to nominate three directors.

Feeling confident that the worst of the obstacles had been smoothed away, the Committee issued a new prospectus dated 26th December, 1825.

It is also given in extenso by Booth. The capital was increased to £510,000. It admitted that there were material errors in the former surveys, and gave an elaborate assurance that everything was now correct. Various alterations in the course were mentioned which met some of the former objections. With regard to locomotives, while still professing their faith in 'this effective machine,' they were good enough to say that 'they will not require any clause empowering them to use it, or that they will submit to any restriction in the employment of it as Parliament may impose, for the satisfaction and ample protection both of proprietors on the line of road and the public at large.'

Further deviations were then specially alluded to, in the case of the estates of Lords Sefton and Derby, and of proprietors generally; they having done their best to avoid game preserves, and to approach places where coal was to be had. They were also not only prepared to give full value for all the land, but 'most anxious to admit that peculiar damage must be met with peculiar compensation.'

The transit of merchandise was to take 'a few hours,' and the question of passenger traffic was brought more into the light than on the former occasion. No less than £100,000 a year was to be saved by the consumers of coal; and the advantages to Ireland were not forgotten.

The new Bill was read a first time in the House of Commons on February 7th, 1826, and passed on the 5th of May. The plans were now unassailable. Vignoles had not surveyed vast tracts of land in America for nothing. In the House of Lords there were only two dissentients, the Earls of Derby and Wilton.

THE FIRST DIRECTORS.

In the Act, as passed, locomotives were clearly taken for granted, since it is merely laid down that every locomotive engine that shall be used on the railway must be constructed to consume its own smoke, on pain of a fine, without any other mention of the subject in all its 200 clauses.



CHARLES LAWRENCE, THE FIRST CHAIRMAN; AS A YOUNG MAN.

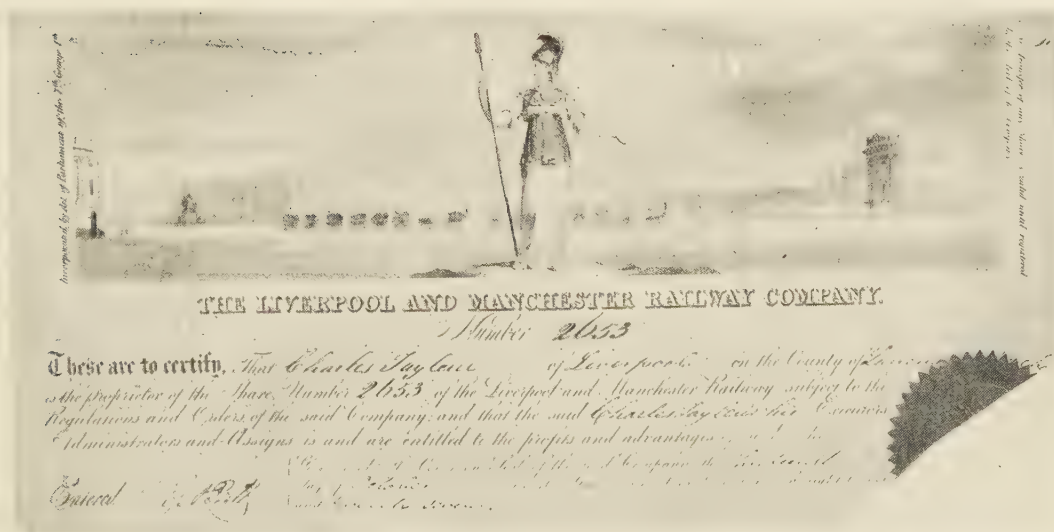
From a miniature in the possession of his grandson.

At the first General Meeting held after the passing of the Act the following directors were elected, namely, by the Marquis of Stafford, Messrs. James Bradshaw, James Loch and James Sothern; by the proprietors, Messrs. Robert Benson, James Bourne, T. S. Brandreth, Lister Ellis, Robert Gladstone, Richard Harrison, Adam Hodgson, Charles Lawrence (Chairman), John Moss, William Rathbone, William Rotherham and Joseph Sandars. Another prominent director, elected in June, 1827, in the place of Brandreth, who had resigned, was James Cropper, a strong advocate of the stationary engine system.

FURTHER ACTS.

The Company set to work without delay, but before giving a description of the task before them, and the means whereby it was accomplished, which forms the subject of a separate chapter, its legal history may be completed here. Owing to funds running short, a second Act was sought and obtained in April 1827, which authorised the borrowing of £100,000 from the Exchequer Loan Commissioners, to enable them to carry on. In March 1828, a third Act was passed, permitting certain minor deviations, and in May 1829, a fourth and final one, which enabled them to enter the sacred precincts of Manchester after all. It included clauses strictly forbidding the use of locomotives within Manchester or Salford, except on the lines as authorised. Apparently there was a fear of the engines running loose on the streets, like wild beasts.

The cost of the Parliamentary campaign was £27,000; nearly £850 a mile.



AN ORIGINAL SHARE CERTIFICATE.

Chapter IV

THE MAKERS OF THE LINE.

DIRECTLY the Act was obtained, the question of appointing a Chief Engineer was discussed. The Rennie brothers, on being consulted, proposed that one of them, namely George, should undertake the superintendence, making six visits a year, and that they should appoint the Resident Engineer¹. They had no objection to George Stephenson taking the locomotive department, which they considered should be distinct from the other works².

These arrangements were not thought satisfactory by the Board, who re-appointed George Stephenson as Chief Engineer in the early part of July, 1826; at a salary of £1,000 a year. The Rennies had fully expected to be employed, and considered that they were badly treated³. It is interesting to know that they intended the gauge to be 5 feet 6 inches⁴, an intention which would have had far-reaching results, if it had been carried out, as it would no doubt have become the standard.

It is unnecessary to enter into details of the life of George Stephenson, as Smiles' biography of him has been so widely read, and everyone is familiar with the general outlines of his career.

¹ Smiles, edn. of 1862, p. 219.

² 'Autobiography of Sir John Rennie,' p. 209.

³ Ibid., p. 208.

⁴ Ibid., p. 239. In connexion with the subject of gauge, Nicholas Wood, when giving evidence before the Gauge Commission of 1845, said: 'I believe the width of 4 feet 8½ was taken from the Killingworth Railway. Mr. Stephenson resided at Killingworth, and it so happened that the width of that railway was 4 feet 8½, and he took that as the width for the Stockton and Darlington, and then afterwards the Liverpool and Manchester was made the same width.' (Question 6184).



PLATE I.
GEORGE STEPHENSON.
1781-1848.

PAINTED BY JOHN LUCAS.

ENGRAVED IN MEZZOTINT BY T. L. ATKINSON.

It is not too much to say that without his dogged perseverance, the success of the locomotive would have been delayed for some, perhaps many, years. Without his persistent arguments, the directors of the Liverpool and Manchester Railway would most likely have been turned aside, and committed to a great expenditure on stationary engines; in fact, as someone said, the line would have been strangled by ropes. He was one of the greatest self-taught geniuses the world has ever seen; though too much stress has sometimes been laid on his powers as a mechanical inventor and designer. But the Liverpool and Manchester Railway was a magnificent work, considering that it was the first of its kind, and that he had neither precedents nor preceptors to guide him; and the credit for the planning and execution of all its parts is due almost entirely to him.

He left the service of the Company about the middle of 1833, afterwards superintending the construction of a great number of railways at home and abroad; retiring from active business in 1840.

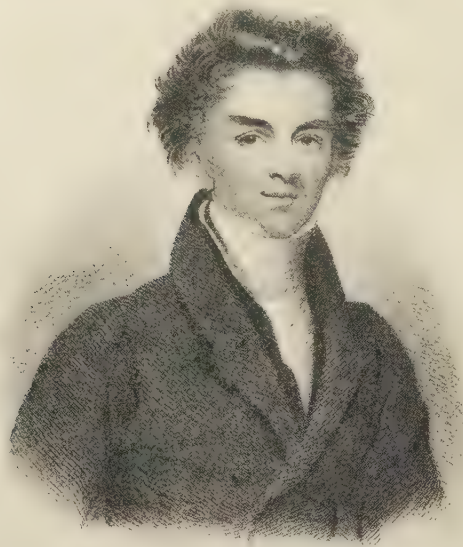
After his death in 1848, the directors of the Midland Railway declared, 'He had left a memory that princes might be proud of, and that the most distinguished man living would be glad to exchange his fame for that which would surround the name of George Stephenson.'

His illustrious son Robert had comparatively little to do with the construction of the line, beyond having been employed in the very early stages to assist James in one of the abortive surveys. In 1824 he went to South America, whence he returned in 1827, and took the leading place at the locomotive factory at Newcastle. His presence was followed almost immediately by a great simplification and improvement in the engines, and the chief credit for the 'Rocket,' which marked a new epoch in locomotive design, is due to him, though it is always popularly supposed to have been the work of his father. The latter must have been too much occupied with making the line at the time to be able to do more than advise and encourage.

After only a few engines on the lines of the 'Rocket' had been built, he produced the 'Planet,' which was another step in advance, of even greater importance; and continued to supply the Company with engines for several years.

ROBERT STEPHENSON.

The salient features of his after career are well known; he proceeded from triumph to triumph; such as the London and Birmingham Railway, the Royal Border Bridge at Berwick-on-Tweed, the High-level bridge at Newcastle-on-Tyne, the Britannia bridge over the Menai Straits and the Victoria bridge over the St. Lawrence at Montreal; not to mention many railways on the continent.



He was M.P. for Whitby from 1847 until his death; and was buried in Westminster Abbey. His life is recorded in Smiles' 'Lives of the Engineers,' and in a separate and more detailed biography by J. C. Jeaffreson.

When the Rennies retired, Vignoles was left on the spot, and began



PLATE II.
ROBERT STEPHENSON.
1803-1859.

PAINTED BY JOHN LUCAS
ENGRAVED IN MEZZOTINT BY SAMUEL BELLIN.

THE ASSISTANTS.

operations by marking out the line, and preparing drains on Chat Moss. Disagreements with Stephenson arose, principally over an error in the survey of



JOSEPH LOCKE
1805-1860.

the tunnel at Liverpool, and he resigned in February, 1827⁵.

He was originally in the army, and then went to America, where he did

⁵ 'Life of C. B. Vignoles,' pp. 116-118.

THE ASSISTANTS.

some notable land surveying. He returned to England in 1823, and set up as an engineer, his first important engagement being in connexion with this railway. He was afterwards engineer to the St. Helens, Wigan, and North Union Railways, all of which connected with the Liverpool and Manchester. He had grand ideas, among them a bridge over the Mersey at Runcorn, and a tunnel under it at Liverpool, both of which came to pass many years later. His life, written by his son, was published in 1889.

Three resident engineers were appointed to serve under George Stephenson, namely, Joseph Locke, John Dixon and William Allcard; Thomas Gooch being chief draughtsman.

Locke afterwards rose to the top of the engineering profession. He had gone to Stephenson as a pupil in 1823 at the age of nineteen. Exactly what portion of the line was carried out by him does not appear, either in Smiles or in Devey's 'Life' of him. It seems that he was paid by Stephenson, who therefore felt at liberty to employ him elsewhere, which in fact he did, during the construction of the line, on making surveys for the Manchester and Stockport Railway. The directors objected; the upshot being that Locke resigned. He was afterwards chief engineer to the Grand Junction, Lancaster and Preston, South Western, Paris and Rouen, Rouen and Havre, and Amsterdam and Haarlem Railways, besides others. He was M.P. for Honiton for thirteen years.

John Dixon began his railway career by surveying the Stockton and Darlington Railway in 1819, and was engaged as one of the resident engineers for that line under George Stephenson, returning to it in 1844⁶.

The section of the Liverpool and Manchester line committed to his charge was the extremely difficult one which included the passage of Chat Moss. Immediately on the opening, he was 'entrusted with the care and management of the engines under Mr. Stephenson's directions⁷.' He made the Canterbury and Whitstable line; and his name subsequently appeared as a director of several railways. Some further details will be found in 'Timothy Hackworth and the Locomotive,' Appendix D; and in an interesting little pamphlet published in 1925, called 'Intimate Story of the Origin of Railways,' by W. D. (Waynman Dixon).

⁶ 'A Century of Locomotive Building,' p. 47. ⁷ Ibid., p. 271.

THE ASSISTANTS.

William Allcard and Dixon were both employed as early as 1825 in connexion with the Birmingham and Liverpool Railway, a line which was not made in its original form. After being employed on the L. and M.R., the former became one of the locomotive engineers on the Grand Junction Railway; his name occurring frequently in the minutes of the directors for 1837 and 1838. He then went to France with Buddicom and established a locomotive factory with him at Rouen.



JOHN DIXON.
1796-1865.

Thomas Gooch was also one of Stephenson's pupils; being allotted to the 'London and South Wales Road' in 1825; another line that never materialized. After being Stephenson's righthand man during most of the construction of the L. and M.R., and making practically all the drawings, he became engineer to the Bolton and Leigh Railway; later, to the Manchester and Leeds. He was brother to Sir Daniel Gooch. His successor as secretary to Stephenson was Frederick Swanwick, afterwards engineer to the North Midland Railway.

Chapter V

THE CONSTRUCTION.

OPERATIONS were begun on Chat Moss, which was one of the last remains of a belt of fen, uncultivated mosses and morasses, stretching across England as late as the 16th century, from the mouth of the Ouse at Lynn to the Mersey. It was thus described by Defoe, in his 'Tour through England' (1724).

The surface, at a Distance looks black and dirty, and is indeed frightful to think of, for it will bear neither Horse nor Man, unless in an exceedingly dry Season, and then so as not to be travelled on with Safety. The Surface seems to be a Collection of the small Roots of innumerable Vegetables matted together, interwoven so thick, as well the larger Roots as the smaller Fibres, that it makes a Substance hard enough to be cut into Turf, or Peat, which in some Places the People pile up in the Sun, and dry for their Fuel.

It does not seem to have altered much in the hundred years that elapsed after Defoe saw it. Much testimony was given in Parliament as to the impracticability of making a line over the Moss; one witness estimating the cost at £270,000. In the end, it turned out to be only £28,000.

The method adopted was to spread hurdles, interwoven with heather, in a double layer with their ends overlapping, thus forming a floating road. In the centre it was found useless to dig drains, as they filled up as quickly as they were made, so lines of empty tar barrels were laid and covered with clay, to form a course for the water. The greatest difficulties of all occurred at the Manchester end, where a slight embankment had to be formed. Here they kept on filling for months without the slightest apparent effect, and at



PLATE III.
VIEW OF THE RAILWAY ACROSS CHAT MOSS.

ACKERMANN'S PRINT NO. 5.

To face page 22.



PLATE IV.

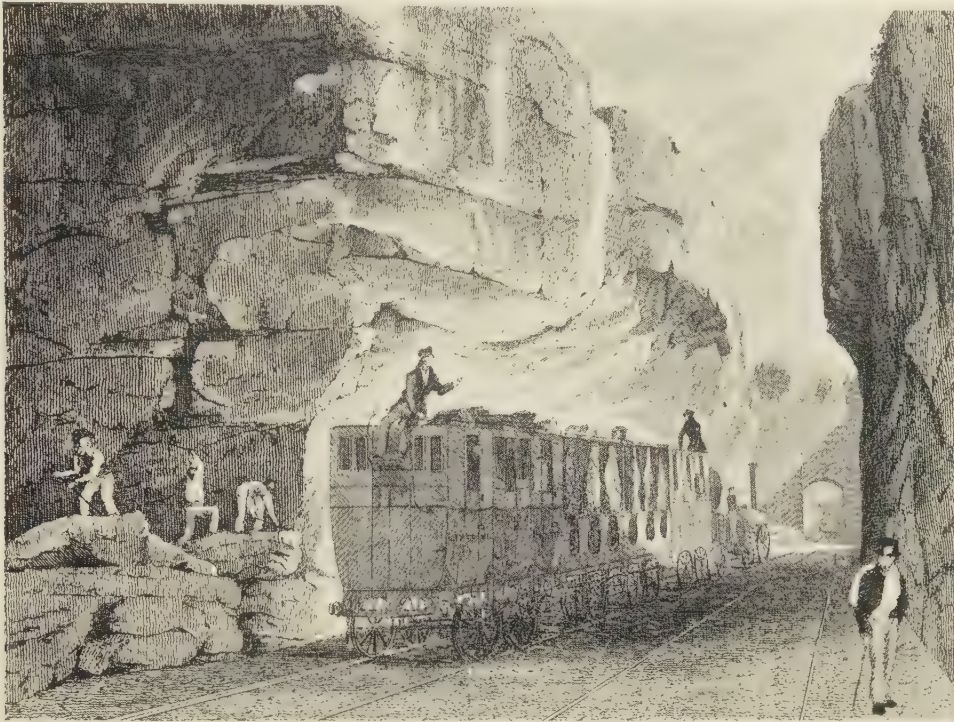
EXCAVATION OF OLIVE MOUNT (4 MILES FROM LIVERPOOL).

ACKERMANN'S PRINT NO. 3.

To face page 23.

THE MOSSES.

one time the abandonment of this part of the line was seriously considered. However, Stephenson never lost heart, and went on filling, until at last the embankment, which was about twenty-five feet deep, although only four or five feet above the surface, began to rise, and this section of the railway was completed on January 1st, 1830. It eventually proved to be the most satisfactory part of the line. A pamphlet published in 1832 described the



OLIVE MOUNT CUTTING.

Shaw's etching No. 6.

travelling over Parr Moss—which was another similar locality, but on a smaller scale—as ‘very much smoother than on the hard and solid ground, like the placid motion experienced in a boat gently gliding over a calm and unruffled sea.’

The alterations made in the course of the line, in order to make it less objectionable to the opposition, had the effect of introducing many difficulties which would have been avoided if it had pursued its original path farther to the north. Liverpool had to be approached by a deep cutting through the

OLIVE MOUNT.

red sandstone at Olive Mount, finishing up with a tunnel under the town. Two banks of 1 in 96 on each side of Rainhill, known as Whiston and Sutton, had to be made, on which it was at first thought that fixed engines would be required; and it was necessary to cross the Sankey Valley at a height of seventy feet above the water.



MILL LANE ARCHWAY, OLIVE MOUNT.

Lithograph by Crane.

The Olive Mount cutting, which is impressive even to-day, is about two miles long, in some parts more than a hundred feet deep, involving the removal of 480,000 cubic yards of stone. It has since been widened to take four lines.



PLATE V.
THE TUNNEL.

ACKERMANN'S PRINT NO. 1.

To face page 24.



PLATE VI.
RAINHILL BRIDGE.
ACKERMANN'S PRINT NO. 12.

THE TUNNEL.

The tunnel under Liverpool, 2,240 yards in length, was another part which caused great trouble and anxiety, owing to the presence of sand and water, and the necessity for avoiding, if possible, any subsidence or damage to the surface. As a matter of fact, one fall did occur. There were also errors in the survey, it being stated that if one had not been discovered in time, two portions would have passed each other without meeting¹.



RAINHILL BRIDGE.

Shaw's etching No. 7.

It was excavated in seven or eight lengths, and when finished, was at first lighted all along by jets of gas. The names of the various streets were put up at the points where they were crossed. It has since been opened up, and widened for four lines.

No less than sixty-three bridges had to be made, either over or under the line. Of the former of these, the most important was the Rainhill bridge,

¹ 'Life of Joseph Locke,' p. 94.

RAINHILL BRIDGE.

which carried a main road over the railway at an angle of 34 degrees, and is a fine example of a skew bridge in masonry, perhaps the first. It is built of stone from a local quarry, and cost £3,735. So far, it is standing up under the modern traffic, in spite of the road over it being paved with stone setts, which must aggravate the vibration caused by the streams of lorries and omnibuses that pour unceasingly over it. If the surface of the road were made as smooth as possible, and well maintained, the conditions would be much less severe. It is much to be hoped that the bridge will last unimpaired until the completion of the proposed new road from Liverpool to Manchester, which will be an immense relief to it.

It is said in the neighbourhood that a full-sized model in wood was set up in a field near by, the stones being afterwards cut to correspond with the wooden blocks. The author's informant had received this story from a well-known local character known to everyone as 'Plug Jack.' The latter used to make the wooden keys for securing the rails in the chairs, and had the reputation of being the first man to engage in that occupation. There is a tablet on each side of the bridge, inscribed as follows:

ERECTED JUNE 1829.

CHARLES LAWRENCE, ESQ.

CHAIRMAN

GEORGE STEPHENSON

ENGINEER.

The coloured view is taken from the Liverpool side, looking in the direction of Manchester. The other is from the opposite side, looking towards Liverpool. The two bridges which can be seen in the latter, a little way off, are still there. The Whiston incline begins just beyond the farther one. The artist must have taken up his position just where the present station is situated. The original station, which was known as Kendrick's Cross, was a little nearer Manchester. A footbridge has been substituted for a level crossing, in consequence of a train running into a carriage and pair, and killing the gatesman and the horses, in 1867.

The Sankey viaduct, which cost £45,000, is built of brick with stone facings. The bridge at Newton, constructed in a similar manner, but with only four arches, was made for £5,340. The last one which calls for mention



PLATE VII.
VIADUCT ACROSS THE SANKEY VALLEY.

ACKERMANN'S PRINT NO. 4.

To face page 26.



PLATE VIII.
MOORISH ARCH, LOOKING FROM THE TUNNEL.

ACKERMANN'S PRINT NO. 10.

To face page 27.



THE SANKEY VIADUCT.
Shaw's etching No. 2.



NEWTON BRIDGE.
Lithograph by Crane.

LIVERPOOL STATION.

is that over the Irwell at Manchester, the cost of which was given by Booth as £8,795, unfinished. He does not include in his list the one over Water Street, Manchester, which lasted until about 1910.

The first station at Liverpool was at Crown Street, which communicated by a tunnel with a deep excavation cut out of the rock at Edgehill, surrounded by walls with battlements, and approached from the other side through a Moorish arch, which was greatly admired at the time, but soon had to go.



Drawn by H. Wall

IRWELL BRIDGE

Lithograph by Colyer.

It connected the two enginehouses for the stationary engines provided to pull the trains up the incline of 1 in 48 in the tunnel. Of the three tunnels shown in the view, the right hand one led to Crown Street; the middle one to the goods warehouses at Wapping, down by the docks, now Park Lane Goods Station; the other being a passage for coals.

The author possesses the original estimate of Robert Stephenson for one fifty H.P. engine, which is reproduced here. It is postmarked in April, 1829. Evidence that this was the tunnel engine is provided by an entry in an old ledger of R. Stephenson and Co., which runs as follows: 'Nov. 19th (1829). The Liverpool and Manchester Rly. Co. For 1—50 horse high press. steam engine for the Tunnel shipped this day per the 'Nimble' to be delivered at Liverpool £1,600 os. od.'



PLATE IX.

ENTRANCE OF THE RAILWAY AT EDGE HILL, LIVERPOOL.

ACKERMANN'S PRINT NO. 2.

To face page 28.



PLATE X.

NEAR LIVERPOOL, LOOKING TOWARDS MANCHESTER.

ACKERMANN'S PRINT NO. 11.

To face page 29.

THE STATIONARY ENGINES.

Although it is stated in one account (Walker's, published by Cannell) that a fixed engine was provided as an auxiliary for the Whiston incline, it is

29 Wounded Street
My Dear Partner
I will engage to put
a 5 horse high pressure engine on
board a vessel at about the
price of £1600 and a competent
person to superintend the
erection of the Engine at Somerset
also free of expense. The proposal
includes the Engine (with boiler
complete as far as the end of
the fly wheel shaft -
No masonry work is included -
The whole of the materials to be
of the very best quality and
fitted up in the most perfect
manner - Any other

certain that there never was one, either there, or at Sutton, the locomotives proving equal to the task, with the assistance of an extra engine, though, it must be admitted, only just so; as the speed was very low by the time they

THE TOTAL COST.

reached the top. It is possible that Walker was deceived by the presence of a building intended to house the engine, but this is mere surmise.

The Manchester terminus was at Liverpool Road, now a goods station.

additional arrangements, may
be postponed until I arrive
in Liverpool which will be
in a few days now -

The Carlish opposition will
be most likely settled in
London, the paragraph in
the Durham paper was false
no arrangement has yet
been made - Hodgson has
withdrawn - Bacon still
continues - Your Affectionate
Pit Rivers
Yours to Lich

The total cost of the line was about £800,000, of which the principal amounts, in round figures, were: bridges, £100,000; cuttings and embankments, £200,000; land, £100,000; parliamentary and law expenses, £28,000.



PLATE XI.

ENTRANCE INTO MANCHESTER ACROSS WATER STREET.

ACKERMANN'S PRINT NO. 6.

To face page 30.



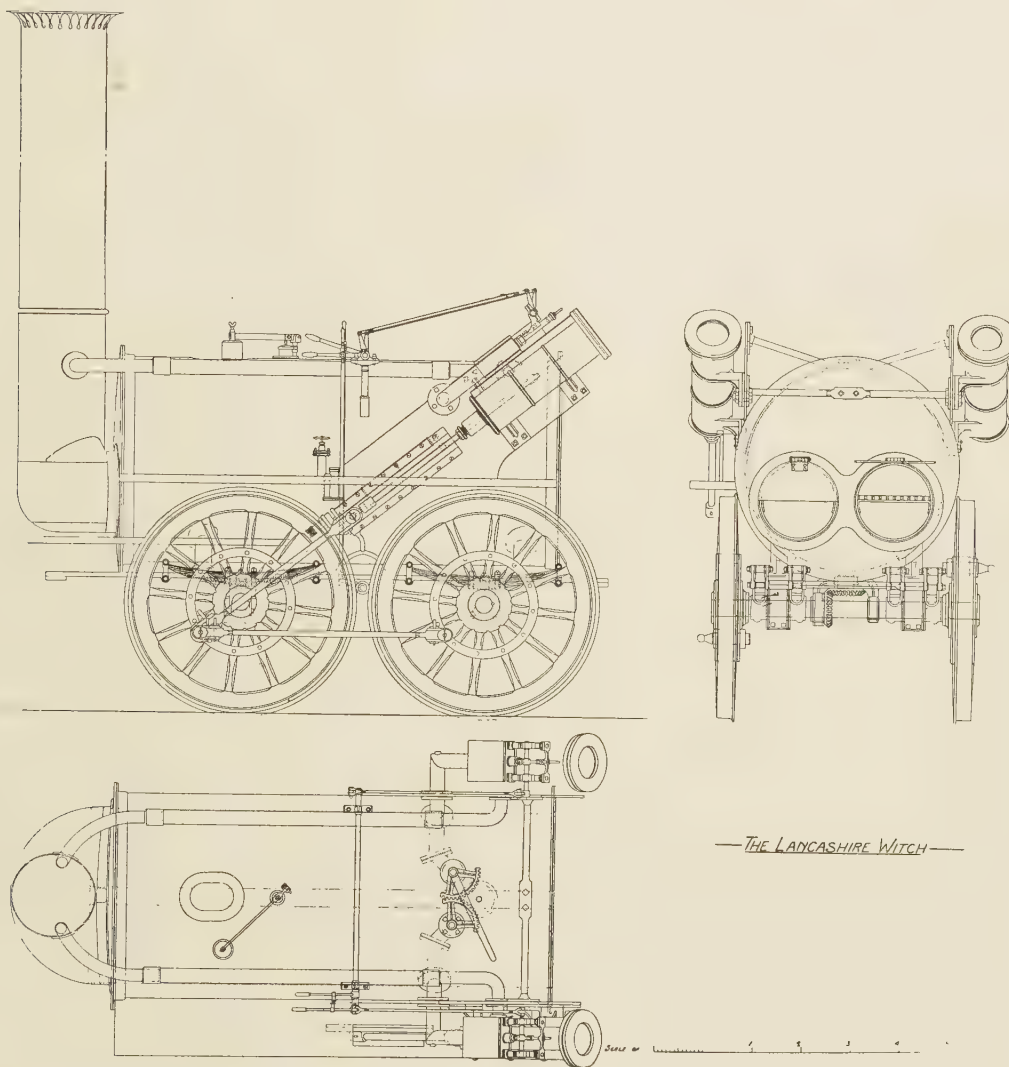
PLATE XII.
WAREHOUSES AT THE END OF THE TUNNEL TOWARDS WAPPING.

ACKERMANN'S PRINT NO. 9.

To face page 31.

THE 'LANCASHIRE WITCH.'

Locomotives were very little used in the construction of the line; partly perhaps because it was made in several detached sections; and, until the end of 1829, Chat Moss formed an impassable barrier. On January 7th, 1828, the directors gave an order for an engine, which turned out to be a remarkable



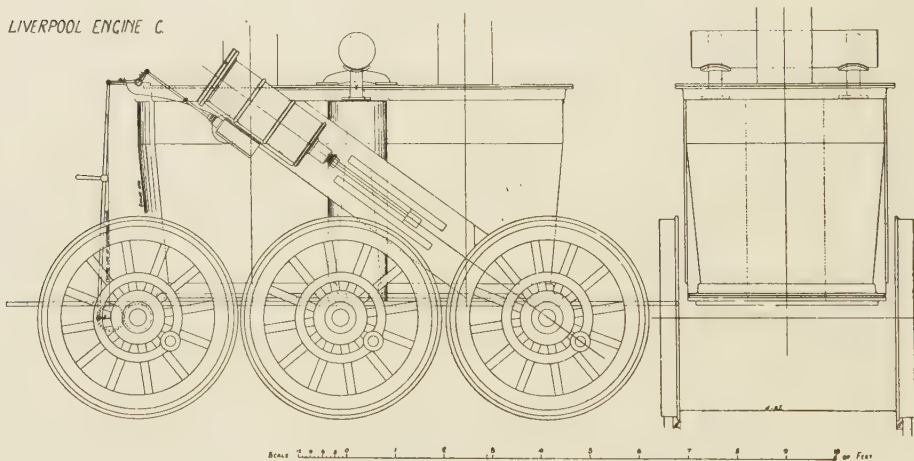
advance in design on any of its predecessors. It was the second to have a direct drive, having been preceded in this respect by Hackworth's 'Royal George,' but the cylinders, instead of being vertical, began to approach their proper position, by being inclined, an improvement due to Robert Stephenson, who had been 'endeavouring to reduce the size and ugliness of our travelling

THE 'TWIN SISTERS.'

engines by applying the engine either on the side of the boiler, or beneath it entirely, somewhat similarly to Gurney's steam coach². The directors however, changed their minds, and on 21st April, 1828, directed Stephenson to transfer the order for the engine to the Bolton and Leigh Railway. Known on the makers' books as the 'Liverpool travelling engine,' it was given the name of 'Lancashire Witch' by its new owners. The price was £580.

The idea of making use of locomotives was abandoned for a year, until March 16th, 1829, when the following minute occurs:

It being thought desirable to work part of the Line between Marle Cutting at the west of Olive Mount and the Broad Green Embankment with a Locomotive engine, Mr. Stephenson was directed to provide an engine for the purpose which he stated he could have ready in 6 or 8 weeks.



THE 'TWIN SISTERS.'

July 13th, 1829.

The Treasurer reported that the Locomotive Engine had arrived from Newcastle by Carlisle and was expected to be ready for operations at Olive Mount in a week.

This engine, called by the makers the 'Liverpool coke engine,' was named the 'Twin Sisters,' by reason of having a double boiler. Price, £550. It was probably the first to use coke.

² Quotation from a letter to Longridge, 1st January, 1828, given in 'A Century,' p. 148.



PLATE XIII.

VIEW OF THE DEEP CUTTING IN THE OLIVE MOUNT.

CLAYTON'S DRAWING NO. 2.

To face page 32.



PLATE XIV.

VIEW OF THE LIVERPOOL AND MANCHESTER RAILWAY
AT THE POINT WHERE IT CROSSES THE BRIDGEWATER CANAL.

CLAYTON'S DRAWING NO. 3.

To face page 33.

THE JOURNEY OF INSPECTION.

The route taken by the engines from Newcastle seems to have been by road across to Carlisle; thence by barge to Bowness, on the Solway Firth; where they were put on steamers for Liverpool.

August 17th, 1829.

Read a letter from Mr. Dixon with statement of the performance of the locomotive engine at Eccles, and expense of working it, exclusive of repairs. Mr. Dixon made the cost of working for 12 hours.....13s. 8d. and to do the work of about 10 horses; or when working night and day, the work of 20 horses for 27s. 4d.

In September the Rainhill trials took place, which are the subject of the next chapter. On October 19th the following occurs:

After discussion it was resolved on the recommendation of Mr. Stephenson that the Rocket steam engine should be taken to Chat Moss, there to be employed in leading ballast, etc. for the formation of the Permanent Road way.

Under date June 14th, 1830, the Minute book contains the following:

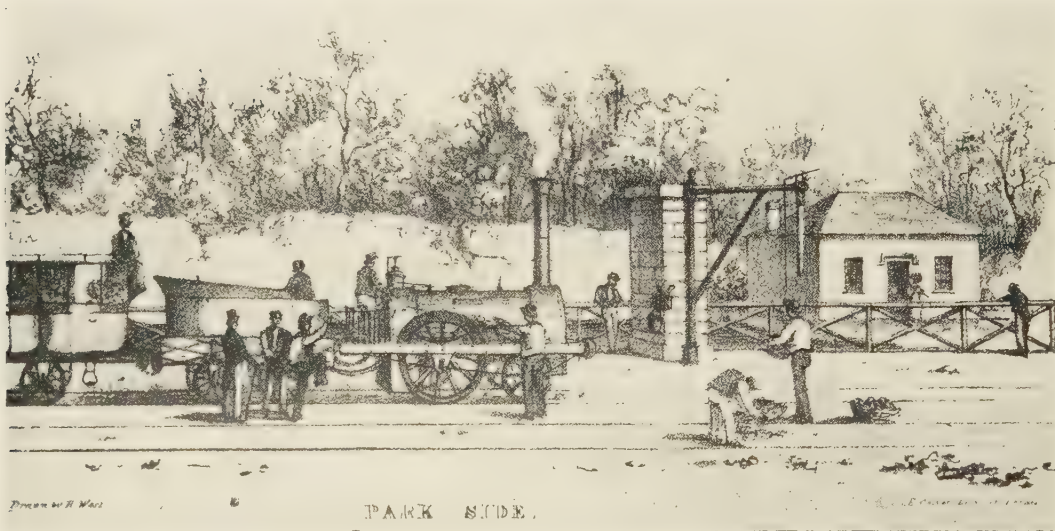
Journey of Inspection and trial of the Locomotive Engine. This day the Directors assembled at the Crown Street Station for the purpose of proceeding to Manchester and back in order to inspect the Works, and prove the capabilities of the Locomotive Engine. The Moving Power was the 'Arrow,' built by R. Stephenson and Co. and the Load *drawn* was about 33 tons, viz.:—

80 stone blocks, in 7 waggons	...	...	20 tons
Wt. of 7 waggons	...	...	7 „
Tender with water and coal and 6 persons	...	...	3 „
Two coaches, viz., the Bolton Close Coach and an open Carriage with 20 persons	...	...	3 „
			33 „

The train started from the Engine House, Edgehill, at twenty minutes before nine, and proceeded to the bottom of the Whiston Inclined Plane, being met a Quarter of a Mile on this side by the 'Dart' Locomotive, which was attached to the 'Arrow' for the purpose of assisting the train up the incline. The whole ascent was effected in 12 minutes; the speed for the first $\frac{1}{4}$ of a mile being 17 miles an hour, which, however, gradually decreased to about 4 miles an hour, before reaching the top. On the summit level at Rainhill, where the line is straight and level, the 'Arrow' proceeded with her load at the rate of 16 miles an hour. She arrived at Oldfield Lane Bridge, Salford,

THE JOURNEY OF INSPECTION.

Manchester, 5 minutes past eleven, having stopped at Parkside, and again near Eccles, to take in water. On the journey homewards the Load consisted of the Engine, Tender and 2 carriages and Passengers. The train started at 6 minutes before five, and arrived at the Liverpool Station at 20 minutes before seven, being 1 hour and 46 minutes on the road, including two stoppages, one at Bury Lane to set down Mr. Hulton, and one at Parkside to take in water.



Lithograph by Colyer.

The ascent of the Sutton Inclined Plane was effected at an average speed exceeding sixteen miles per hour, and the rate of movement on other parts of the road was frequently 25 miles per hour and upwards, the engine working below her power a great portion of the way.

At Manchester the following resolution was unanimously passed:

‘ That the Directors cannot allow this opportunity to pass without expressing their strong sense of the great skill and unwearied energy displayed by their Engineer, Mr. George Stephenson, which have so far brought this great national work to a successful termination, and which promise to be followed by results so beneficial to the country at large, and to the Proprietors of this concern.’

The opening took place on September 15th, 1830.

Chapter VI

THE RAINHILL TRIALS.

PERHAPS there is no more striking illustration of the pioneer character of this railway than the fact that it was more than three years before the directors were able to decide what motive power was to be employed.

In September, 1828, they sent a deputation to Darlington to inspect the working of the railway there, and at the beginning of 1829, being in fact divided into two parties, one favouring locomotives, the other, stationary engines, they commissioned James Walker and John Rastrick, both well-known engineers of the day, to visit certain colliery railways, and report on the comparative merits of the two systems.

The question was not an easy one to settle. There seemed little to choose as regards speed. The stationary engine had advanced to a comparatively high state of efficiency and reliability. The locomotive, on the other hand, was in a very primitive stage of development; rattling, wheezing, leaking at every pore, it ground its way painfully along the rough track, and often broke down altogether. But 'trouble on the road,' frequent though it may have been, was a mere trifle compared to a failure with the fixed engine system, which paralysed everything. And it was rightly thought that there were more possibilities of improvement in the locomotives than in the other engines.

The locomotives known to have been at work in 1824 have been enumerated in Chapter II, eighteen in all. By 1829 eight more had come into existence; two at Springwell Colliery (sometimes called Mount Moor),

near Newcastle, by Stephenson, and three more, also by him, on the Stockton and Darlington Railway; all except one being of the same primitive design, with vertical cylinders sunk in the boiler, and return connecting-rods¹. The last-mentioned line had also added an engine to its stud which was a remarkable advance, namely Hackworth's 'Royal George'; the first to be direct acting, and certainly the most powerful that had been built.

The two remaining ones were the 'Lancashire Witch,' described in the last chapter, and Rastrick's 'Agenoria,' on the Shutt End Railway near Stourbridge, which is now in the South Kensington Museum.

Most of these engines were inspected by Walker and Rastrick. They also examined the Brunton and Shields Railway, which was worked by stationary power. Their report went into minute details of the work done by the various engines, which are of little interest at the present day. From what they saw, they were only able to anticipate locomotives of ten horsepower, moving at ten miles an hour. They considered the stationary system safer than locomotives. If the latter were to be used, they recommended Hackworth's return-tube boiler, so that the 'fireplace' should be at the end farther from the train.

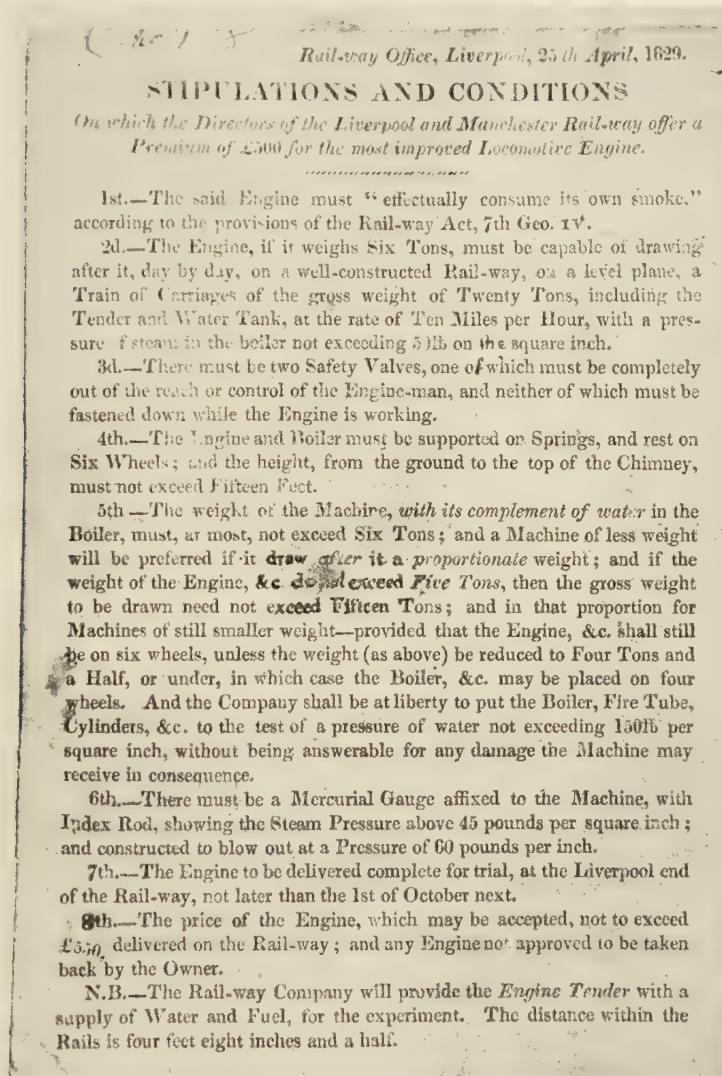
On the whole, the report, while leaning to the side of fixed engines, was far from decisive; and the question was summed up by Walker to the effect that if it was wished to make the railway complete at once, the stationary system was the best; but if preferred to proceed by degrees, and proportion the power of conveyance to the demand, they recommended locomotive engines on the line generally, with two fixed engines on the Whiston and Sutton planes, to draw up the locomotives as well as the goods and carriages. (Another was required for the tunnel at Liverpool; the only one that was eventually installed). He then went on to suggest that if the latter plan be adopted, something in the way of a premium might be held out for the best locomotive.

After considering the report, together with some 'Observations' on it, by Robert Stephenson and Locke, the two parties on the board came to a kind of compromise, passing a resolution that they were of opinion that it would be inexpedient to determine on a system of fixed engines for the whole line,

¹ To the credit of the Springwell engines, it should be mentioned that one of them remained at work for about fifty years.

THE 'STIPULATIONS AND CONDITIONS.'

and that the discussion should be postponed until the arrival of a locomotive which they had already ordered². In the mean time they acted upon Walker's suggestion, and resolved to offer a prize of £500 for a locomotive



engine ‘which shall be a decided improvement on those now in use, as respects the consumption of smoke, increased speed, adequate power and moderate weight.’

The conditions decided upon were printed on a card, reproduced above.

² Minutes of Directors, 20th April, 1829. The engine was the ‘Twin Sisters.’

THE 'RACE CARD.'

As soon as the offer became known, the directors were inundated with suggestions of the most absurd kinds. Of serious competitors, however, there were very few. In the *Mechanics' Magazine* for October 10th, 1829, it is

N^o 2-

LIVERPOOL, OCTOBER 5, 1829.

A LIST OF THE ENGINES

Proposed to be run at RAINHILL, on the 5th of OCTOBER instant,

FOR

THE PREMIUM OF £500,

OFFERED BY

The Directors of the Liverpool and Manchester Rail-road,

FOR THE

BEST LOCOMOTIVE POWER.

No. 1.—Messrs. Braithwaite and Ericsson, of London; "The Novelty;" Copper and Blue; weight 2t. 15cwt.

2.—Mr. Ackworth, of Darlington; "The Sans Pareil;" Green, Yellow, and Black; weight 4t. 8cwt. 2q.

3.—Mr. Robert Stephenson, Newcastle-upon-Tyne; "The Rocket;" Yellow and Black, White Chimney; weight 4t. 3cwt.

4.—Mr. Brandreth, of Liverpool; "The Cycloped;" weight 2t. 17cwt. worked by a Horse. *320 lbs*

5.—Mr. Burstall, Edinburgh; "The Perseverance;" Red Wheels; weight 2t. 17cwt.

The Engines to be ready at Ten o'Clock on Tuesday Morning. The Running Ground will be on the Manchester side of the Rainhill Bridge. The Load attached to each Engine will be three times the weight of the Engine.

No Person, except the Directors and Engineers will be permitted to enter or cross the Rail-road.

J. U. RASTRICK, Esq., Stourbridge, C.E.
NICHOLAS WOOD, Esq., Killingworth, C.E.
JOHN KENNEDY, Esq., Manchester, } Judges.

stated that the number was first reported to be ten, and they had reason to know that there were at least as many engines as this in preparation. If the above is correct, there were five candidates who did not come up to the scratch. The following were possibly among them:

William Brown, the inventor of the 'gas-vacuum' engine, which had

THE 'ROCKET.'

been tried unsuccessfully in a stationary form, in a boat and a road-carriage. It bore much the same relation to the modern gas engine as that of Newcomen did to Watt's. Brown had written in June, asking if it would be eligible, and received a favourable reply³.

One O. W. Hahr gave notice in August of an engine to be offered for trial⁴, but all traces of it have been lost.

Another was certainly Edward Bury, who was at work on his first engine, the 'Dreadnought,' but did not finish it in time.

One would have expected Goldsworthy Gurney to have entered. He afterwards negotiated for the supply of an engine, but was unable to agree to the terms proposed.

A Mr. Wight of Edinburgh had submitted a plan and description of a locomotive in 1828, which was reported unfavourably upon by George Stephenson. Probably it never got beyond paper.

Those which actually faced the starter are given in the illustration opposite, which is a reproduction of one of the original 'race-cards.'

THE ROCKET.

To take the 'Rocket' first, it was entered by George and Robert Stephenson, and Henry Booth. The latter, who was the secretary and treasurer of the line, suggested the tubes in the boiler, which appear to have been quite an independent idea of his, although Seguin was actually building an engine with tubes at the time in France. To Booth we also owe the screw-coupling, one of which is shown on his statue in St. George's Hall, Liverpool. In 1846 he became secretary for the Northern Division of the L. and N.W.R. and was made a director in 1848, retiring in 1859. A 'Memoir' of him, by Robert Smiles, was published in 1869.

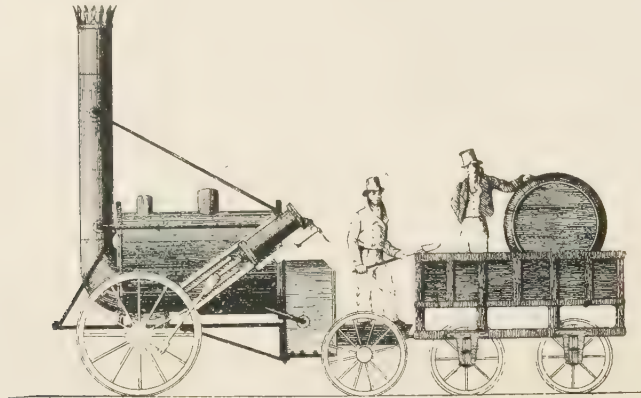
The earliest known illustration of the 'Rocket' is one given in the *Mechanics' Magazine* for October 24th, 1829. On November 28th, another appeared, in which some trivial inaccuracies were said to be corrected. The latter one is shown on the next page. Both were probably drawn by Vignoles.

³ Minutes, 29th June, 1829.

⁴ Ibid, 31st August, 1829.

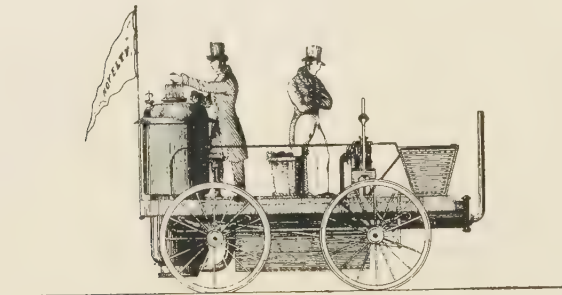
THE LOCOMOTIVE STEAM ENGINES

Which competed for the Prize of £500 offered by the Directors of the Liverpool and Manchester Railway Comp^y - drawn to a scale $\frac{1}{4}$ inch to a foot



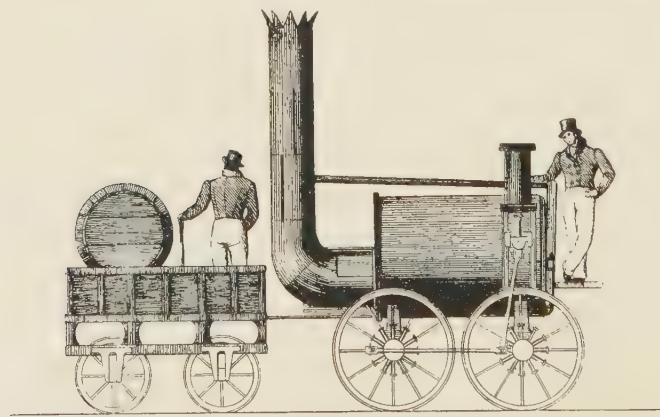
The ROCKET of Mr. Rob^t Stephenson of Newcastle

*Which drawing a load equivalent to threetimes its weight travelled at the rate of 12½ miles an hour, & with a carriage & passengers at the rate of 24 miles
Cost per mile for fuel about three halfpence*



The NOVELTY of Mess^{rs} Braithwaite & Ericsson of London.

*Which drawing a load equivalent to three times its weight, travelled at the rate of 20½ miles an hour; & with a Carriage & Passengers at the rate of 32 miles!
Cost per mile for fuel about one halfpenny*



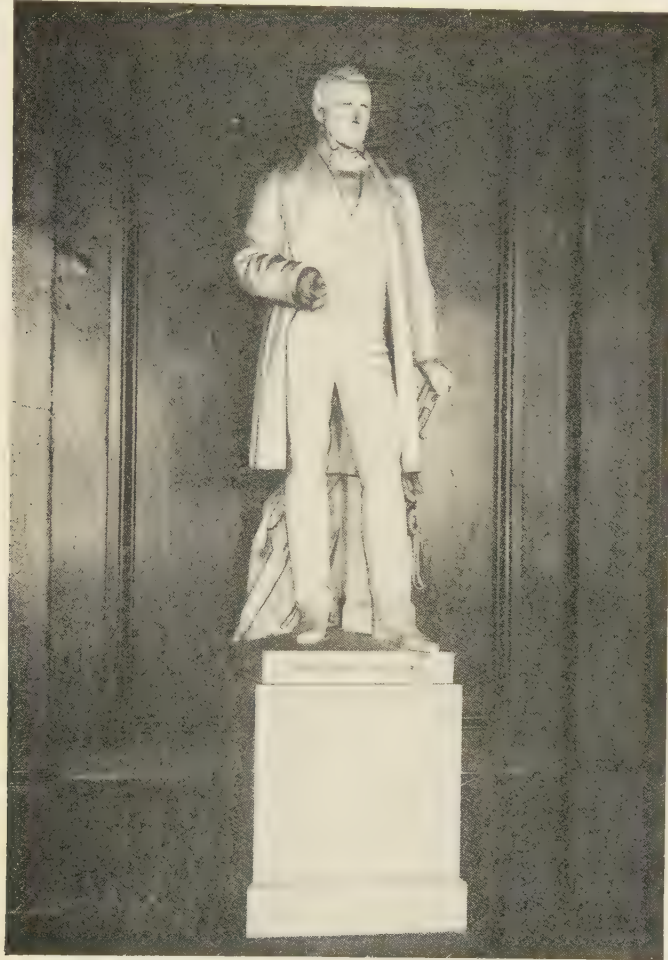
C. Burden del^l on. Bone

The SANS PAREIL of Mr. Hackworth of Darlington

Which drawing a load equivalent to three times its weight, travelled at the rate of 12½ miles an hour - Cost for fuel per mile about two-pence

THE 'ROCKET.'

The trailing wheels are rather too far back, as in the existing engine their centre is almost under the back of the firebox, and it is hardly likely that their position has been altered. Otherwise, it may be accepted as correct, except perhaps for one more small point, namely the little chamfer on the upper



STATUE OF HENRY BOOTH.

rear corner of the firebox. The illustration in the second edition of Wood's 'Treatise on Railroads,' 1831, shows this corner square, but in the third edition (1838) a different figure was substituted, with it bevelled off; which was presumably meant for a correction. But there is now a fresh witness to call. The author has had the good fortune to obtain Rastrick's notebook, which he used at the trials, and which is transcribed in the Appendix. He

THE 'ROCKET.'

shows the firebox with the corner square, and with a dry back. Wood, however, says it was surrounded by water, 'except at the bottom, and on the side next the boiler.'⁵ But Rastrick was evidently the one who took the particulars down.

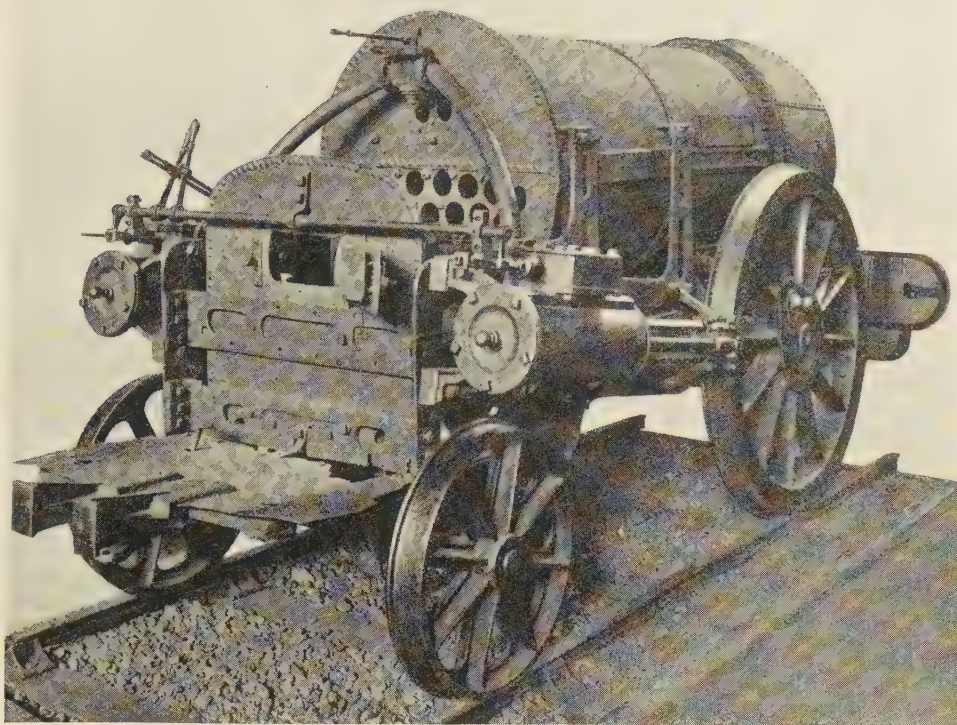
The general design followed that of the 'Lancashire Witch'; the chief difference being the substitution of a small pair of trailing wheels for a pair coupled to the drivers, and, of course, the tubular boiler. The wheels were 4 feet 8½ and 2 feet 6 (or 8½, Rastrick's figure), respectively. The cylinders, which were inclined at an angle of 35 degrees, were 8 inches diameter by 17 stroke. The evidence about the latter is conflicting, as Rastrick says it was 16½ inches; the figure also given by Wood, who probably trusted to him. It is remarkable that he should have made a mistake in so important a dimension, but there seems to be no escape from this conclusion, as the driving wheels now on the engine have a 17 inch stroke, and have every appearance of being the original ones. The latter figure is also given in a 'description book,' as it is called of Messrs. Stephenson's, dated 1831. The boiler, which was 3 feet 4 in diameter, and 6 feet long, contained 25 copper tubes, 3 inches in diameter; working pressure 50 pounds per square inch. There were two exhaust outlets in the chimney, one for each cylinder.⁶ The weight in working order was 4¼ tons; 2 tons 12 cwt. 1 quarter on the driving wheels, and 1 ton 12 cwt. 3 quarters on the trailers⁷. There was a mercurial pressure-gauge, reaching nearly all the way up the chimney. The reason for making the wheels 4 feet 8½, the same as the gauge, was possibly because this dimension corresponds almost exactly to one revolution per second at ten miles an hour. Subsequently to the competition, the cylinders were lowered to a nearly horizontal position, being changed over, so that the valves came on the top instead of below; and a smokebox was fitted.

The engine was employed on the Liverpool and Manchester Railway until 1836. A minute of the directors dated 24th October in that year records that it was sold to Mr. James Thompson of Carlisle for £300. It worked on the Midgeholm Colliery line until 1844; was sent to London in 1862, and is now in the South Kensington Museum. The remains are shown opposite, from a photograph taken in 1923. The firebox has disappeared.

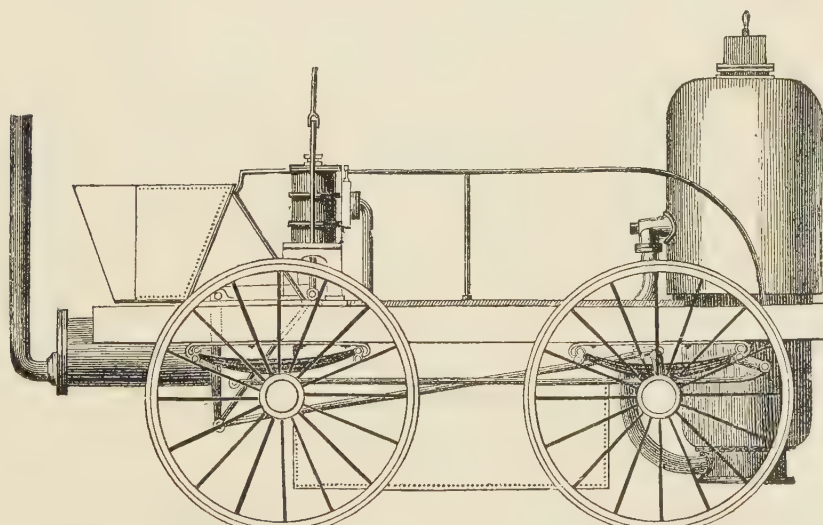
⁵ Treatise on Railroads, III Edn., p. 324.

⁶ Ibid., p. 511: Robert Stephenson's statement in Smiles' 'Lives'; edn. of 1862, p. 503.

⁷ Rastrick's notebook.



THE 'ROCKET' IN 1923.



"THE ENGINEER"

SWAIN SC

THE 'NOVELTY' (from *Mechanics' Magazine*).

THE 'NOVELTY.'

THE NOVELTY.

The 'Novelty,' which was built in London, was entered by John Braithwaite and John Ericsson. The former afterwards became engineer to the Eastern Counties Railway. Ericsson emigrated in 1839 to the United States, afterwards becoming famous as the builder of the 'Monitor.'



We have again a contemporary illustration of the engine in the *Mechanics' Magazine* for October 17th, 1829. The wheels were 4 feet 2 inches diameter, 6 feet apart; on the suspension principle, patented in 1826 by Theodore Jones. They are still in existence, at the South Kensington Museum. At first they were coupled by a chain, but it was found unnecessary, and removed before the trial^s. The original cylinders, which have also survived, are

^s *Mechanics' Magazine*, Vol. XV, p. 39.

THE 'NOVELTY.'

6 inches by 12. They were vertical, and drove through bell-cranks to a crank-axle. Barton's pistons, with metallic packing⁹, were used.

The boiler, the barrel of which was 10 feet long, and only 13 inches in diameter, contained a small tapering flue, which returned on itself twice.



James Martin, Esq.
J. E. Martin

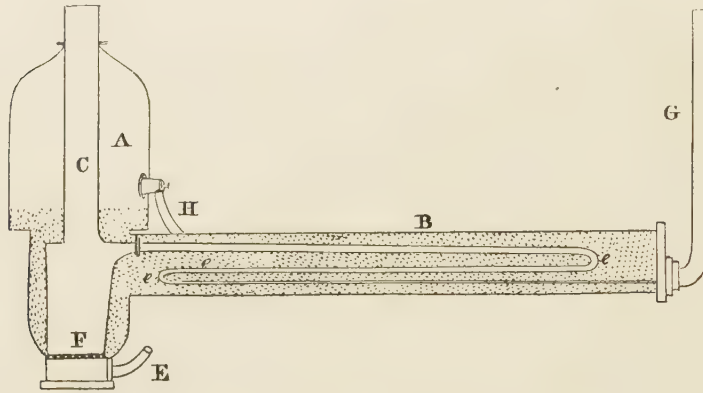
[At the time he built the Princess, 1841.]

The fuel was introduced through the top of the firebox. Air was forced into a closed ashpan by bellows worked by the engine. The weight in working order was 3 tons 17 cwt. The fuel and water were carried on the engine, so that no tender was required. The 'Novelty' was not purchased by the directors; it was afterwards used on the St. Helens, and on the North Union

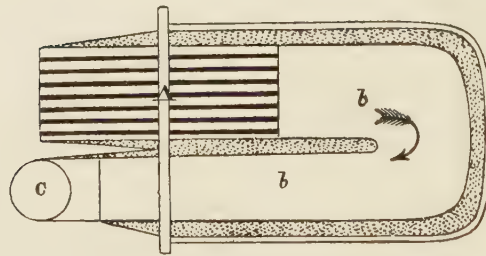
⁹ Hebert's 'Practical Treatise on Railroads,' 1837; p. 144.

THE 'SANS PAREIL.'

Railways. By 1833 it had been rebuilt, with a new boiler and other alterations, details of which will be found in the Appendix. In an article by W. P. Paley in the *Railroad Gazette* for April, 1905, it is said to have been sold to the Preston and Longridge Railway, which was opened May 1st, 1840.



BOILER OF THE 'NOVELTY' (AFTER WOOD).



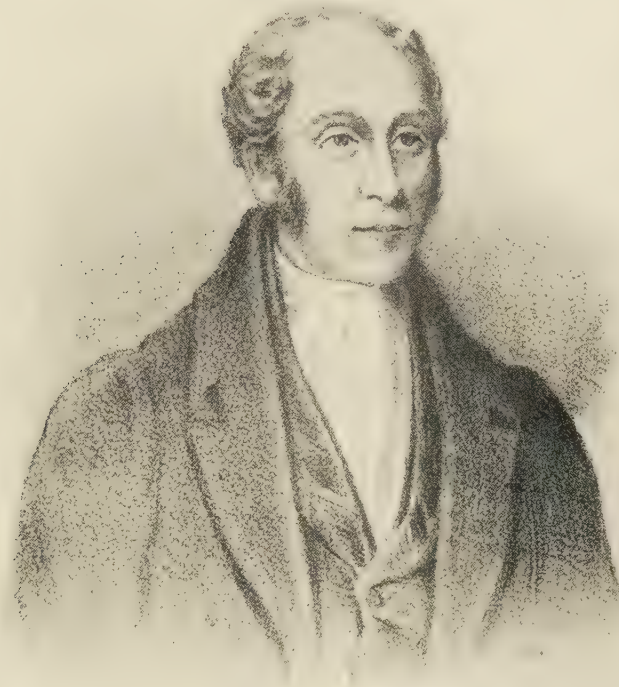
BOILER OF THE 'SANS PAREIL' (AFTER WOOD).

THE SANS PAREIL.

The 'Sans Pareil' was designed by Timothy Hackworth, who was the Engine Superintendent of the Stockton and Darlington Railway. It is now in the South Kensington Museum. The wheels were 4 feet 6 inches diameter, coupled. The boiler was 4 feet 2 inches diameter by 6 feet long,

THE 'SANS PAREIL.'

with a return flue; the chimney and grate being at the same end. Some of the early illustrations of this engine err in putting the tender at the wrong



Timothy Hackworth

end. The cylinders, 7 inches by 18, were vertical, and inverted over the trailing wheels. The weight in working order was 4 tons 15 cwt. 2 quarters, and therefore over the $4\frac{1}{2}$ which was prescribed as the limit for four wheels; however, the trial was allowed to proceed.

THE 'SANS PAREIL.'

The minutes of the directors record that it was purchased for £550, and let on hire to the Bolton and Leigh Railway for £15 per month, being sold



THE 'SANS PAREIL' TO-DAY.

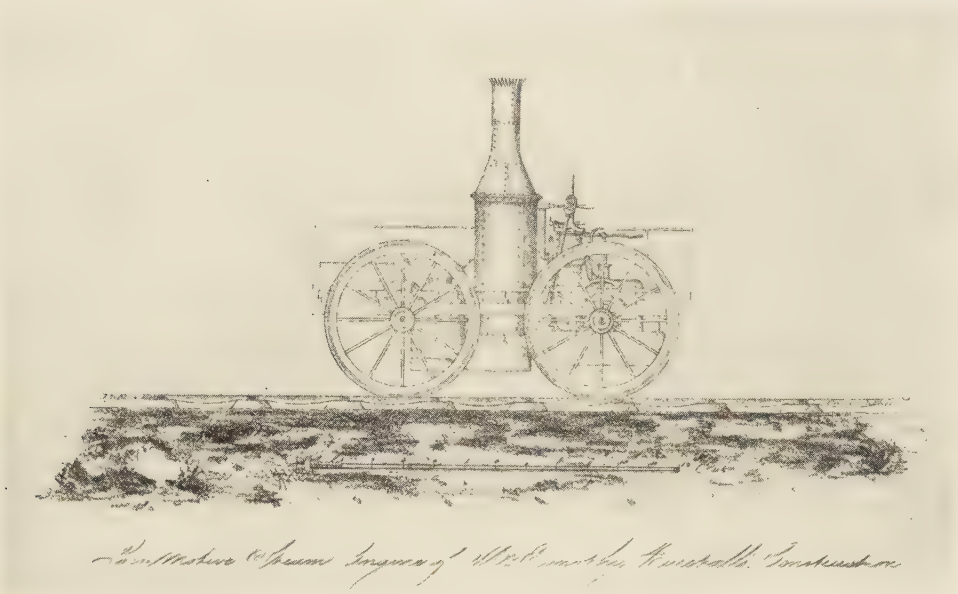
By permission of the Director of the Science Museum.

outright to that line in 1832 for £110. There it worked till about 1840. It was then used at a colliery for pumping until 1863, when the mine became exhausted, and it was restored and sent to London.

THE 'PERSEVERANCE.'

THE PERSEVERANCE.

The 'Perseverance' was entered by Timothy Burstall of Leith. Its feeble performance caused it to be almost completely ignored in all the accounts, but there now seems no doubt that it is represented by an old lithograph which has recently been discovered, and is shown here.



Burstall had built a steam road coach with the boiler at the back of the body in 1824. In 1826 he took out a patent for a six-wheeled coach, with the boiler carried on an articulated frame separate from the body, and a two-cylinder engine similar to the one illustrated here. Luke Hebert, in a supplement to Galloway's 'History and Progress of the Steam Engine,' 1831, illustrates the first coach, and a model of the second. He states that the 'mechanical combinations' of the 'Perseverance' were nearly similar to those of the coach described on the page showing the first one. But the *Mechanics' Magazine*¹⁰ gives a description pointing clearly to the second coach as its prototype (which is of course more likely), and, as Hebert gives two other wrong references to pages immediately before and after this one, it is practically certain that he meant to indicate the second, and not the first; which would be in accord with the illustration that has now come to light.

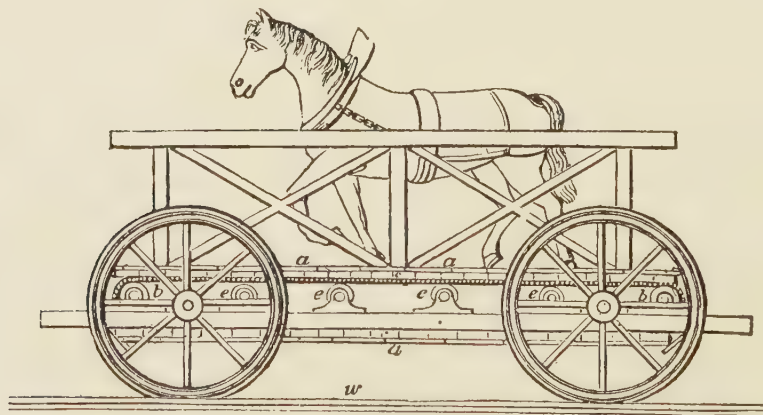
¹⁰ Vol. XII, p. 163.

THE 'PERSEVERANCE.'

The coach in question had a pair of vertical cylinders, driving, by means of return connecting-rods, a countershaft which turned the axle by gear wheels. The illustration here appears in complete agreement, except that the boiler—which hardly comes under the term 'mechanical combination'—appears to have been fed with fuel below, through a hopper, whereas in the coach it was put in from above.

It has been suggested that this drawing might have been intended, not for the 'Perseverance,' but for a second engine (perhaps only a reconstruction?) which Burstall said he was preparing for the opening of the railway¹¹, but was never heard any more of. But it does undoubtedly agree closely with the coach engine, as we are told the 'Perseverance' did; whereas nothing is known about the design of the other, which was probably never finished. The subject is also discussed, with other evidence, in the author's 'Two Essays.' No dimensions of the 'Perseverance' are known, except the weight, which was 2 tons 17 cwt. Like the 'Novelty,' it carried its own fuel and water¹².

The only remark of interest made by Wood on the subject is that the boiler consisted of an upright generator, 'the heated air and flame escaping up the chimney without any flues to abstract the redundant heat.'¹³ Rastrick's notebook does not mention the engine.



(*Brandreth's Patent Cyclopede. 1829.*)

¹¹ Minutes of directors, 15th Jan. 1830.

¹² *Liverpool Times*, 13th Oct. 1829.

¹³ 'Treatise on Railroads,' III edn. p. 330.



PLATE XV.
NICHOLAS WOOD.
1795-1865.

FROM A PICTURE BY H. W. PHILLIPS, IN THE POSSESSION OF SIR ARTHUR WOOD, BART.

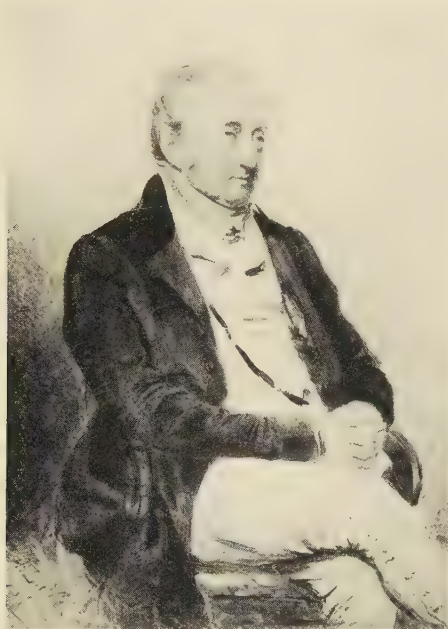
THE JUDGES.

THE CYCLOPEDE.

This was an absurd affair, entered by T. S. Brandreth of Liverpool, one of the directors. It was worked by a horse moving an endless platform with his feet. All the known representations of it appear to have been copied from one in Galloway's 'History and Progress of the Steam Engine,' and only show one horse, but the machine exhibited at Rainhill had two.

THE JUDGES.

Three judges were appointed, namely Nicholas Wood of Killingworth, John Urpeth Rastrick of Stourbridge and John Kennedy of Manchester.



JOHN KENNEDY (1769-1855). *From a picture in the possession of Lady Sinclair.*

Wood was the chief engineer at the Killingworth Collieries, and had therefore had fifteen years' experience of locomotive work.

Rastrick was in partnership with William Foster in a steam engine factory at Stourbridge, where four locomotives were built about this time, three of which went to America; the other being the 'Agenoria,' which has already been mentioned. He was afterwards engineer to many railways, including the Brighton.

THE TRIALS.

Kennedy was a cotton spinner and inventor, the originator of some improvements in spinning machinery. It does not appear from either Wood's or Rastrick's account that he took any active part in the trials. He had a brother James, who was no doubt the James Kennedy who became Bury's partner in the Clarence Foundry, Liverpool. He was first cousin to the Reverend John, father of the late Sir Alexander Kennedy.

THE TRIALS.

On the day before the trials, the following regulations were issued from the railway office :

The engines to be ready at ten o'clock on Tuesday morning.
The running-ground will be on the Manchester side of the Rainhill Bridge.

The load attached to each engine will be three times the weight of the engine.

No person, except the Directors and Engineers, will be permitted to enter or cross the railroad.

Liverpool, 5th Oct., 1829.

The first day of the competition was Tuesday, the 6th October; the place being a level stretch at Rainhill, about nine miles from Liverpool. Four posts were set up; first, the starting-post; then after $\frac{1}{8}$ of a mile, a post called No. 1, at which Rastrick was stationed; after a mile and a half, No. 2, where Wood took up his position; then another $\frac{1}{8}$ mile to the end, at which the engines stopped, and returned to the start. The course seems to have been from just west of the Rainhill bridge to Lea Green. The gradients have altered slightly in the course of time, Lea Green appearing to have sunk bodily.

A grand stand was erected, which contained the beauty and fashion of the neighbourhood. There was also a great concourse of engineers from all over the country, and a numerous sprinkling of Quakers, whose appearance on a race-course was the subject of much amusement.

No provision seems to have been made for doing small repairs on the spot, which omission caused some lengthy delays that might have been much shortened. There was evidently a weigh-bridge, as the weights on the wheels of two of the engines were taken separately, while with regard to the 'Sans Pareil,' Rastrick records that the wheels 'all stood on the Plate of the Weighing Machine, and it was in consequence all weighed at once.'

THE TRIALS.

Contemporary accounts of the proceedings are both numerous and full; there is the one by Wood, which he gave in the second and third editions of his 'Treatise'; we now have Rastrick's notes; there is a description by Booth in his 'Account of the Liverpool and Manchester Railway'; one by Robert Stephenson and Joseph Locke, which was appended to their Reply to Walker's Report; and an account in the *Mechanics' Magazine* of October 10th, 1829 and succeeding numbers, which was written by Vignoles¹⁴. There is also a certain amount of information to be gathered from the ordinary press of the time. The following summary has been drawn from all the above sources.

Tuesday, October 6th.

The first runs were made by the 'Rocket,' which drew 12 tons 9 cwt. at the rate of 12 miles an hour¹⁵; and ran light at about 18¹⁶; or, according to another account, 24¹⁷; also with a load, including passengers, of 13 tons, at 15 miles an hour.

The 'Sans Pareil' made a trip light.

Mr. Brandreth's horse-locomotive also showed its paces, 'not in the way of competition, but as exercise. About fifty persons clung round the waggons, giving a gross weight with the machine of about five tons, and with this weight, the horses (themselves moving scarcely one mile and a quarter an hour) propelled the waggons and load exactly at the rate of five miles an hour¹⁸.'

The sensation of the day was provided by the 'Novelty,' which attained 28 miles an hour without load, and caused great excitement. An eye-witness wrote:

It seemed to fly, presenting one of the most sublime spectacles of mechanical ingenuity and human daring the world ever beheld. It actually made one giddy to look at it, and filled the breasts of thousands with lively fears for the safety of the individuals who were on it, and who seemed not to run along the earth, but to fly, as it were, on the wings of the wind.

¹⁴ 'Life of C. B. Vignoles,' p. 128.

¹⁵ Rastrick's note book.

¹⁶ *Mechanics' Magazine* vol. XII, p. 115.

¹⁷ *Liverpool Courier*, 7th Oct., 1829.

¹⁸ *Ibid.*, same date.

THE 'ORDEAL.'

During the day there was also a demonstration of a 'manumotive' carriage invented by Winans, which was propelled by two men, and took six passengers. We are informed that it moved 'with no great velocity.'

TRIAL OF THE LOCOMOTIVE ENGINES.

LIVERPOOL & MANCHESTER RAIL WAY.

The following is the Ordinal which we have decided each Locomotive Engine shall undergo, in contending for the Premium of £500, at Rainhill.

The weight of the Locomotive Engine, with its full complement of water in the boiler, shall be ascertained at the Weighing Machine, by eight o'clock in the morning, and the load assigned to it, shall be three times the weight thereof. The water in the boiler shall be cold, and there shall be no fuel in the fire-place. As much fuel shall be weighed, and as much water shall be measured and delivered into the Tender Carriage, as the owner of the Engine may consider sufficient for the supply of the Engine for a journey of thirty-five miles. The fire in the boiler shall then be lighted, and the quantity of fuel consumed for getting up the steam shall be determined, and the time noted.

The Tender Carriage, with the fuel and water, shall be considered to be, and taken as part of the load assigned to the engine.

Those Engines that carry their own fuel and water, shall be allowed a proportionate deduction from their load, according to the weight of the engine.

The Engine, with the Carriages attached to it, shall be run by hand up to the Starting Post, and as soon as the steam is got up to fifty pounds per square inch, the engine shall set out upon its journey.

The distance the Engine shall perform each trip, shall be one mile and three quarters each way, including one-eighth of a mile at each end for getting up the speed, and for stopping the train, by this means the engine with its load, will travel one and a half mile each way at full speed.

The Engine shall make ten trips, which will be equal to a journey of thirty-five miles, thirty miles whereof shall be performed at full speed, and the average rate of travelling shall not be less than ten miles per hour.

As soon as the Engine has performed this task, which will be equal to the travelling from Liverpool to Manchester, there shall be a fresh supply of fuel and water delivered to her, and as soon as she can be got ready to set out again, she shall go up to the Starting Post and make ten trips more, which will be equal to the journey from Manchester back again to Liverpool.

The time of performing every trip shall be accurately noted, as well as the time occupied in getting ready to set out on the second journey.

Should the Engine not be enabled to take along with it sufficient fuel and water for the journey of ten trips, the time occupied in taking in a fresh supply of fuel and water, and shall be considered and taken as part of the time in performing the journey.

J. U. RASTRICK, Esq. Stourbridge, C. E.
NICHOLAS WOOD, Esq. Killingworth, C. E. } Judges.
JOHN KENNEDY, Esq. Manchester,

Liverpool, Oct. 6, 1829.

Wednesday, October 7th.

The 'Novelty' opened the proceedings, and did one trip loaded at 20¾ miles an hour, after which the bellows burst. The weather was very bad, and nothing more was done, except a few exhibition runs.

Thursday, October 8th.

This morning a surprise was in store for the competitors, as they were handed a small buff card, reproduced above, containing fresh conditions; the

THE TRIALS.

judges having come to the conclusion that the original ones were not sufficiently definite. The chief point about the 'ordeal,' as it was called, is that the engines were required to run seventy miles practically continuously, at an average of not less than ten miles an hour.

The serious business of the competition now began, the 'Rocket' starting off at 10.36, and completing the required distance without a hitch, at an average of about 16 miles an hour, the greatest speed being over 29. The trips in one direction were faster than in the other, owing to the trucks being pulled when going out, and pushed on the return. The consumption of water was 114 gallons, and of coke 217 pounds, per hour. The records of the runs, from Rastrick's notebook, are reproduced in the Appendix. The performance all day was wonderfully consistent, and Rastrick records that at the conclusion the steam was 'as strong as at the commencement, namely 50 pounds per square inch.'

Friday, October 9th.

On this day nothing seems to have taken place, the reason being either a dispute on the part of the owners of the 'Novelty' about the 'ordeal', or else that adjustments were found necessary to that engine.

Saturday, October 10th.

The 'Novelty' came up for trial; the load assigned to it, after considerable discussion, being 6 tons 17 cwt. On the very first trip the feed-pipe burst, owing to the engine-man having closed a cock between the pump and boiler. While it was being repaired, the 'Rocket' did two runs without the tender, at 30 miles an hour.

In the afternoon the 'Novelty' did some exhibition runs, much to the delight of the company; in one of which it took a carriage with about forty-five ladies and gentlemen at 30 miles an hour. The *Mechanics' Magazine* described the speed as such 'that we could scarcely distinguish objects as we passed by them.' This remark is very interesting, as it suggests that our eyesight has since gone through a gradual, but hitherto undetected, process of adaptation, which is not at all unlikely.

Nothing was done on Monday, October 12th.

THE TRIALS.

Tuesday, October 13th.

The 'Sans Pareil' came forward, and started on the allotted task. On the eighth trip the pump ceased working, the water level fell and the lead plug melted. The plug was replaced, and steam got up, but the pump went wrong again, and the further trial was abandoned. The speed was about 14 miles an hour, with a maximum of 16½. The consumption worked out to 150 gallons of water, and no less than 692 pounds of coke, per hour.

It appears that the trial of this engine had been delayed for some days by leaks in the boiler¹⁹, which had been made in the Bedlington Iron Works. The excessive consumption was put down by Wood to the unnecessarily sharp blast²⁰. He criticises the 'Rocket' on the other hand, as not having enough²¹. The difference between the amount of draught required for the two engines was, of course, very great. In the case of the 'Sans Pareil,' part of the effect was due to a crack which occurred in one of the cylinders, allowing steam to blow through to the exhaust. In the course of controversies which raged in the past, much capital was made out of this faulty cylinder, which had been cast at the Stephenson works. The evidence for it is contained in a draft of a letter from Hackworth to the directors after the trial²². From the way in which it is put—he speaks of *a* cylinder which had failed, not of *the* cylinder—it is fairly clear that it was intended to be taken as news, and therefore that the defect was small enough to have remained latent, and not to have been discovered until afterwards. Neither Wood, the *Mechanics' Magazine*, nor Rastrick mentions it, and the minute entries of the latter relating to the various hitches and failures make it almost certain that he would have recorded it, if he had known of it.

Wednesday, October 14th.

The 'Novelty' again faced the starter, but on the second trip, a boiler joint blew out; it was said owing to the cement not having had time to set, and the owners withdrew.

The 'Perseverance' then made some 'experimental' trials, but appeared to be only capable of five or six miles an hour, and was also withdrawn. This

¹⁹ Wood, III edn. p. 316.

²⁰ Ibid. p. 509.

²¹ Ibid. p. 311.

²² Quoted in 'Timothy Hackworth and the Locomotive,' p. 203.

END OF THE TRIALS.

engine, like the 'Novelty,' may have been handicapped by a hasty repair; as it appears that they let it fall when unloading it, injuring one of the cranks and breaking a pipe²³, and probably straining it generally.

The prize was awarded to George and Robert Stephenson, and Henry Booth, a consolation prize of £25 being given to Burstall²⁴.

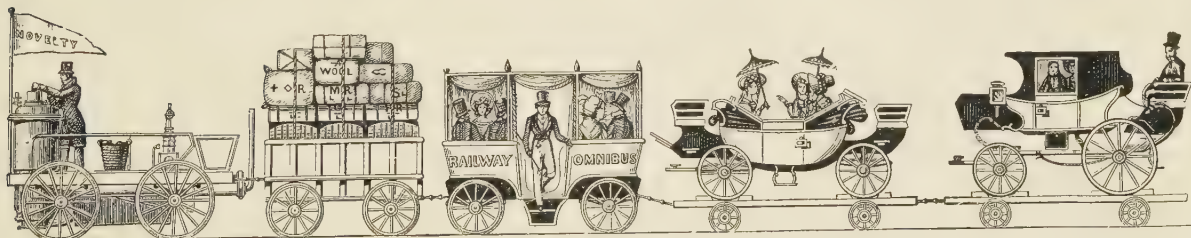
The actual report made by the judges to the directors, on which the award was based, has not come down. But the tenor of it is obvious. Only one of the starters stayed the course. It may be remarked that both Rastrick and Robert Stephenson considered the load imposed much too small.

The result of the trials was to establish the locomotive in an unrivalled position as the motive power of the future; and not solely on the ground of speed. There is no doubt that the ease with which the Whiston incline was climbed by the locomotives, especially by the 'Rocket,' led to the abandonment of the stationary engines which had previously been thought essential there and at Sutton.

No contemporary illustrations of the scene have been found. A small woodcut in Smiles 'Lives,' which has been copied by subsequent writers, was evidently drawn for the book, from imagination. Another sketchy representation is known, but the copies seen by the author certainly do not go back to 1829, or anything like it.

²³ Minutes, 5th October, 1829.

²⁴ Ibid. 20th Oct., 1829.



THE 'NOVELTY' AND TRAIN; *from a drawing by Vignoles.*

Chapter VII

THE OPENING DAY.

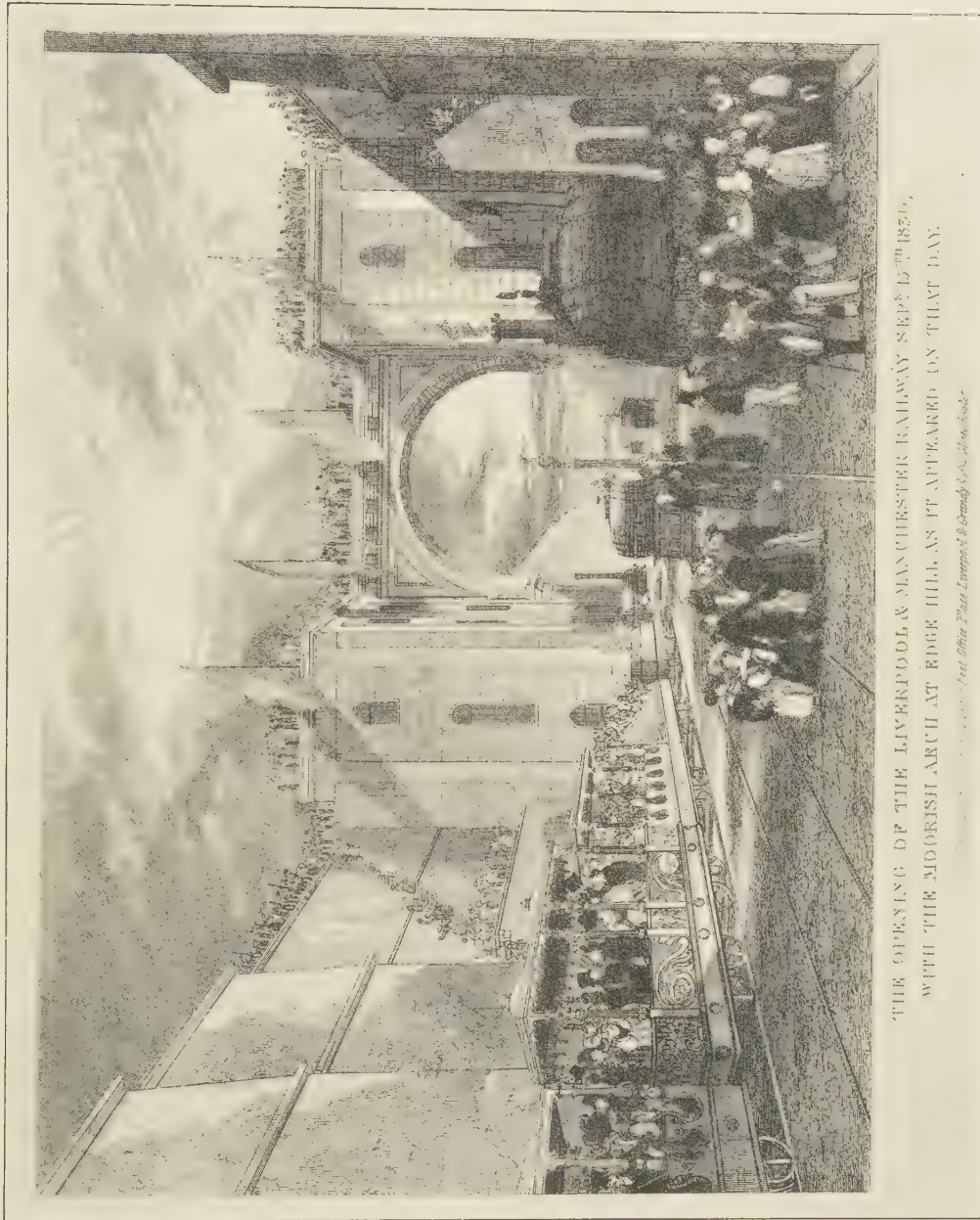
THE railway was opened, with much pomp and ceremony, on the 15th September, 1830. All obstructions were cleared away, and, such was the anxiety that no accident should occur to mar the proceedings, every crossing was removed, except one at Huyton, a precaution which afterwards proved to be highly inconvenient.

The guests assembled at Crown Street, Liverpool, in the morning. Among them were many distinguished persons, including the Duke of Wellington, Marquis of Salisbury, Prince Esterhazy, Sir Robert Peel and William Huskisson. There were eight trains, as follow :

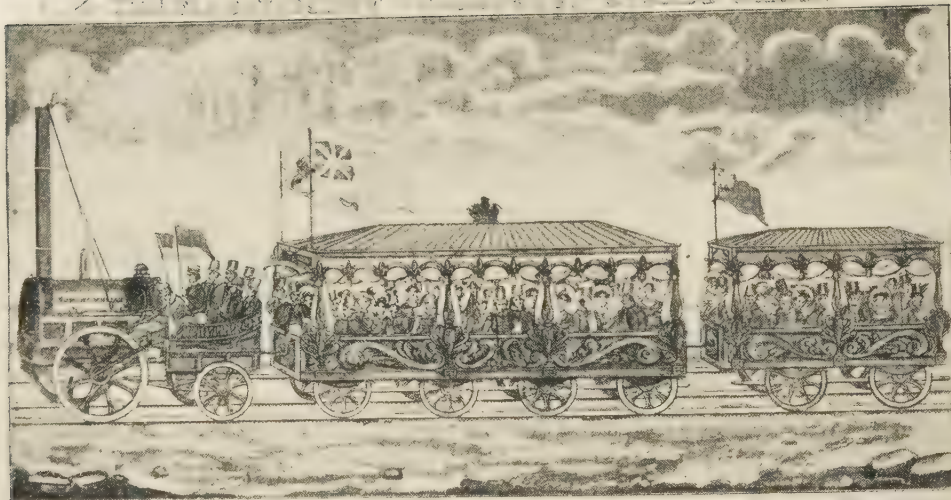
<i>Engine.</i>		<i>Flag.</i>		<i>Driver.</i>
Northumbrian	...	Lilac	...	George Stephenson
Phoenix	...	Green	...	Robert Stephenson, junr.
North Star	...	Yellow	...	Robert Stephenson, senr.
Rocket	...	Light Blue	...	Joseph Locke
Dart	...	Purple	...	Thomas L. Gooch
Comet	...	Deep Red	...	William Allcard
Arrow	...	Pink	...	Frederick Swanwick
Meteor	...	Brown	...	Antony Harding

The first train contained a band, and a remarkable 'state carriage,' in which the principal guests were accommodated. A contemporary account states :

This carriage was truly magnificent; its appearance was imposing, and its workmanship was perfect and tasteful; superb Grecian scrolls and balustrades, richly gilt, supported a massy handrail running round the carriage, while ascending from it were gilded pillars, maintaining a canopy of 24 feet long, so contrived as to be lowered at pleasure; the drapery was of rich



Shaw's etching No. 1.



ERECTED TO COMMEMORATE THE
in which his Grace the Duke of Wellington & his Friends Honoured the Occasion

From a crude coloured lithograph.

Opening
OF
THE LIVERPOOL AND MANCHESTER
RAILWAY,
WEDNESDAY, 15TH SEPTEMBER, 1830.

CHAS. LAWRENCE, CHAIRMAN.

THE BEARER OF THIS TICKET IS ENTITLED TO SEAT No. *34*
 NORTH STAR'S TRAIN.

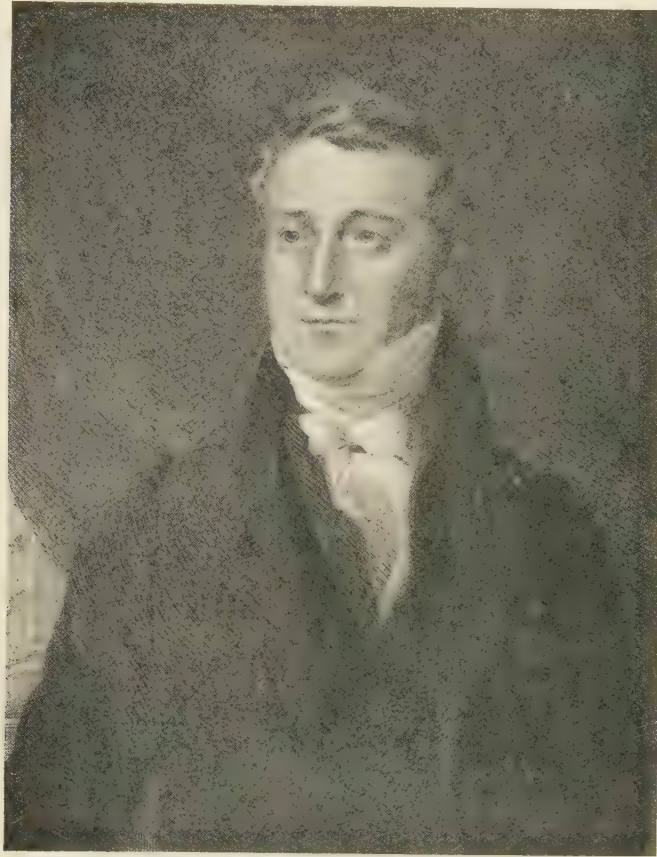
YELLOW FLAG.

A TICKET FOR THE OPENING. *Another type was similar, but larger (4¼ by 3½ inches), and was without the part entitling the bearer to a seat in one of the trains.*

THE ACCIDENT.

crimson cloth, and the whole was surmounted by the Ducal coronet; the interior had an ottoman seat, and the floor was 32 feet long by 8 feet wide, running upon eight large iron wheels.

A cannon was fired at twenty minutes to eleven, and the 'splendid cavalcade' started on its way, the first train being on the southern line, and



WILLIAM HUSKISSON.
1770-1830.

the rest on the northern. All went well until they arrived at Parkside, about half way, where a stop was made for water, and some of the visitors alighted, among whom was Mr. Huskisson. He was speaking to the Duke of Wellington, when the 'Rocket' came up on the other line, and struck him down. He was lifted into one of the carriages, and taken on by the 'Northumbrian' to Eccles, where he died during the evening.

THE RETURN JOURNEY.

Great consternation was caused by this tragedy, and a consultation was held as to the best course to adopt. The Duke and many of the other guests were in favour of giving up all further proceedings, which were to have included a luncheon at Manchester, but it was represented to them that the railway would suffer a severe blow if the journey were not completed, and that a breach of the peace would be likely to occur; so it was decided to go on to Manchester, but to omit all festivity there. After a delay of an hour and a half, a fresh start was made; two trains being coupled together on the north line, which drew the Duke's train by a chain.

The delay in the arrival of the trains, together with vague rumours of a fearful accident, had excited the crowds of spectators beyond all control. Stones were thrown, and the station at Manchester was found to be occupied by a dense mob, which pressed on the Duke's carriage. The uproar was so great, that it was thought wise to get him away as soon as possible, so the 'Northumbrian' was once more coupled on, and started back for Liverpool. This step caused a most awkward complication. There were as yet no arrangements at Manchester for obtaining water, and the intention had been that the engines should run four miles back to Eccles, and fill up, during the luncheon interval. Four of them had gone, and were in front of the Duke's train, on the same line. Owing to the crossings having been taken up, they had to go on all the way to Huyton—within six miles of Liverpool—before they could be turned on to the other line. Only three engines, the 'Rocket,' 'North Star' and 'Arrow,' were left to haul the remaining vehicles, which were made into a single train, and eventually left Manchester at twenty minutes past five, in pouring rain. On re-starting from Eccles, where they had stopped for the purpose of enquiring for Huskisson, some of the couplings broke, and had to be replaced by ropes. At Parkside they were met by the three wandering engines, two of which were attached, while the third, the 'Comet,' was sent ahead as a pilot, with instructions to signal obstacles by holding out a lighted tar-rope.

The climb up to Rainhill proved too much for the engines, and all the men were made to walk. Relieved of their weight, the train managed to struggle to the summit. On the level, the pilot ran over a wheelbarrow which had been maliciously placed on the line, fortunately without accident, and Liverpool was finally reached at ten o'clock.



PLATE XVI.

PARKSIDE

(THE STATION WHERE MR. HUSKISSON FELL).

ACKERMANN'S PRINT NO. 13.

To face page 62.

THE MEMORIAL.

So ended this memorable day in the world's history. The unhappy victim was a great and justly esteemed statesman, who was member for Liverpool at the time, and had been a good friend to the railway; he spoke in its favour in the House of Commons, and encouraged the directors to make fresh efforts on the failure of the first Bill in Parliament. A monumental slab at the side of the line marks the spot where the accident occurred.



An interesting letter from Dr. J. P. Brandreth, who attended him after the accident, was published in the *Cornhill Magazine* for December, 1913.

Chapter VIII

THE LINE AS A GOING CONCERN.

THE railway became a centre of great interest, and the passenger traffic was so heavy, that a report spoke apologetically of only being able to convey goods 'with the few engines that can be spared.' The first load of merchandise was taken from Liverpool to Manchester on December 4th, 1830, by the 'Planet,' weighing 80 tons¹. By the end of the year they had carried 70,000 passengers, with only one slight mishap. In the year 1831 the receipts from passengers amounted to nearly half a million pounds.

Several interesting contemporary accounts of journeys by the railway in the early days have come down. A fascinating one by Fanny Kemble, the actress, is given in Chapter XIX of 'A Century of Locomotive Building.' The 'Creevy Papers' contain an amusing one of a run before the opening. The excursion, which took place in November, 1829, was described as a '*lark* of a very high order,' and consisted of a ride of five miles, at twenty miles an hour, which was called *frightful*. To quote further:

It is really flying, and it is impossible to divest yourself of the notion of instant death to all, upon the least accident happening. It gave me a headache which has not left me yet. Sefton is convinced that some damnable thing must come of it. . . . Altogether I am very glad to have seen this miracle, and to have travelled in it . . . having done so, I am quite satisfied with my first achievement being my last.

In 'Notes and Queries,' 4th series, vol. ii, p. 101, there is an extract from a diary dated Oct. 27, 1830, which gives one interesting detail not to be found elsewhere:

¹ *Mechanics' Magazine*, Vol. XIV, p. 284.

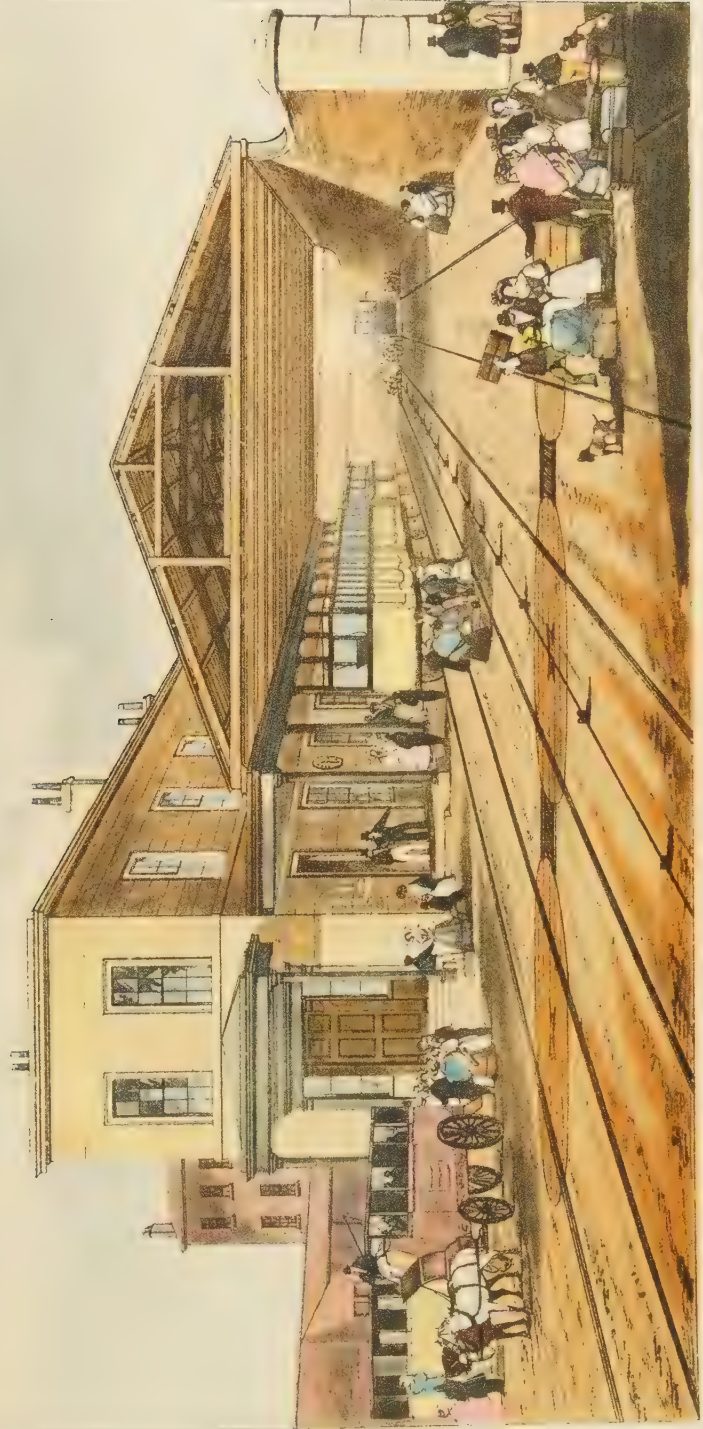


PLATE XVII.
RAILWAY OFFICE, LIVERPOOL

ACKERMANN'S PRINT NO. 8.

To face page 64.

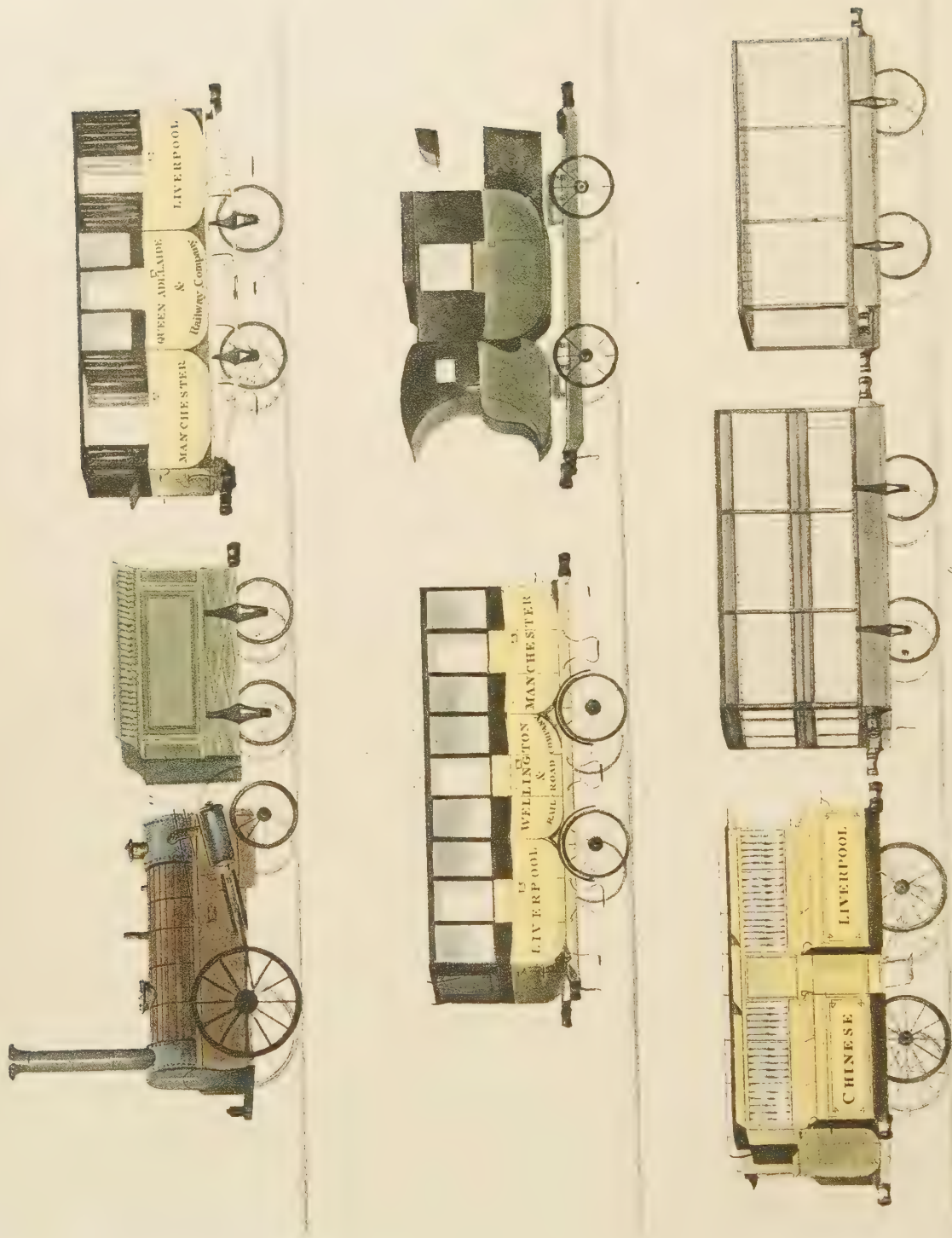


PLATE XVIII.
COACHES, ETC., EMPLOYED ON THE RAILWAY.

ACKERMANN'S PRINT NO. 7.

To face page 65.

TRAVELLING IN THE EARLY DAYS.

We were two hours and a half going to Liverpool. . . . there is a long tunnel . . . too low for the engines at present in use, and the carriages are drawn through it by donkeys When the carriages stop or go on, a very violent jolting takes place, from the ends of the carriages jostling together.

Buffers seem at first to have been absent altogether; very soon they appeared, made of padded leather. The screw-coupling, as already mentioned, was invented by Booth, and spring buffers may also have been originated by him.

Another interesting description occurs in Hare's 'Memorials of a Quiet Life,' Vol. I, p. 281. There the carriages are said to have been drawn through the tunnel by a horse.

The following account, which has never been printed, is an extract from the diary of a tour in 1831, by Colonel Pownoll Phipps, of the Hon. East India Company.

April 5. After partaking of a hasty breakfast, I got, at seven o'clock, on the celebrated railway, and found myself at Liverpool in an hour and a half. An omnibus took up the passengers with their luggage at the office in the town of Manchester, and conveyed them to the outskirts where the railway begins, and on the Liverpool side there are similar conveyances ready to carry them near the Town Hall. I observed that one small locomotive engine, with a car of coals behind, was fastened to six carriages each having three bodies holding six persons; the seats divided by small bars. They are regularly numbered, and the ticket delivered at the office for five shillings shows the seat to which you are entitled. Thus all confusion is avoided. The ends of the carriages have strong leather mufflers to soften the force of the blow when they come in contact with each other, which frequently occurs when the engine stops. We stopped for water at a half-way house, and once to regulate something out of order. The speed was by no means uniform, but varied considerably. At every mile a watchman is stationed to keep the way clear from stones, and to prevent any tricks being played to injure the railway. We first passed on the road a string of carriages like our own, coming from Liverpool. The velocity with which both bodies are moving, separated only by a space of two or three feet, gave a terrific appearance to this occurrence, although, in reality there is no danger, when each person keeps his seat, and does not put the head out of the window. We next passed, in the same manner, some open cars, the price of a seat in which is only two shillings and six pence; but passengers are exposed to inconvenience from the steam, and in the winter they must be very cold, going so rapidly through the air. The last carriages we

TRAVELLING IN THE EARLY DAYS.

passed were platforms laden with merchandise and poultry. A gentleman's carriage was conveyed across on one of these platforms.

On arriving at a tunnel near Liverpool the steam-carriage was taken off, and the coaches slowly moved under the rocky arch by ropes turned by steam, and on clearing the dark passage, omnibuses were in readiness to convey the passengers to their inns. No fees of any description are taken, and the whole is very well managed. Two hundred tons of cotton had recently been conveyed across in one trip by two locomotive engines, in two hours and a half, the charge for which was one hundred pounds, or about a farthing for conveying four pounds and a half of cotton thirty one miles.

One more contemporary account contains a passage sufficiently entertaining to quote :

The first class train is the most fashionable, but the 2nd or 3rd are the most amusing. I travelled one day from Liverpool to Manchester in the lumber train. Many of the carriages were occupied by the swinish multitude, and others by a multitude of swine. It is evident that the other passengers would have been considerably annoyed by the orators of this last group, had there not been stationed in each carriage an officer somewhat analogous to the Usher of the Black Rod, but whose designation on the Railroad I found to be Comptroller of the Gammon. No sooner did one of the long-faced gentlemen raise his note too high, or wag his jaw too long, than the Comptroller of the Gammon gave him a whack over the snout with the butt-end of his shillelagh, a snubber which never failed to stop his oratory for the remainder of the journey.

The rails used were rolled iron, fifteen feet long, weighing 35 lb. per yard. Eighteen miles of them were laid on stone blocks spaced three feet apart, which were afterwards removed; and the other fourteen on oak sleepers, these being used on the embankments. As time went on the rails gradually rose up to 75 lb. per yard.

The locomotives will be dealt with subsequently. At first some very weird experiments appear to have been made in designing the carriages, judging by some of the illustrations. For some years the first-class ones were all named, in imitation of the coaches. A contemporary description² says :

The most costly and elegant contain three apartments, and resemble the body of a coach (in the middle) and two chaises, one at each end,—the whole joined together. Another resembles an oblong square of church pews, panelled at each

² 'An Accurate Description, etc.,' by J. S. Walker, 1830.



A FIRST CLASS CARRIAGE OF ABOUT 1838



THE 'ROCKET NO. II', BUILT IN 1929

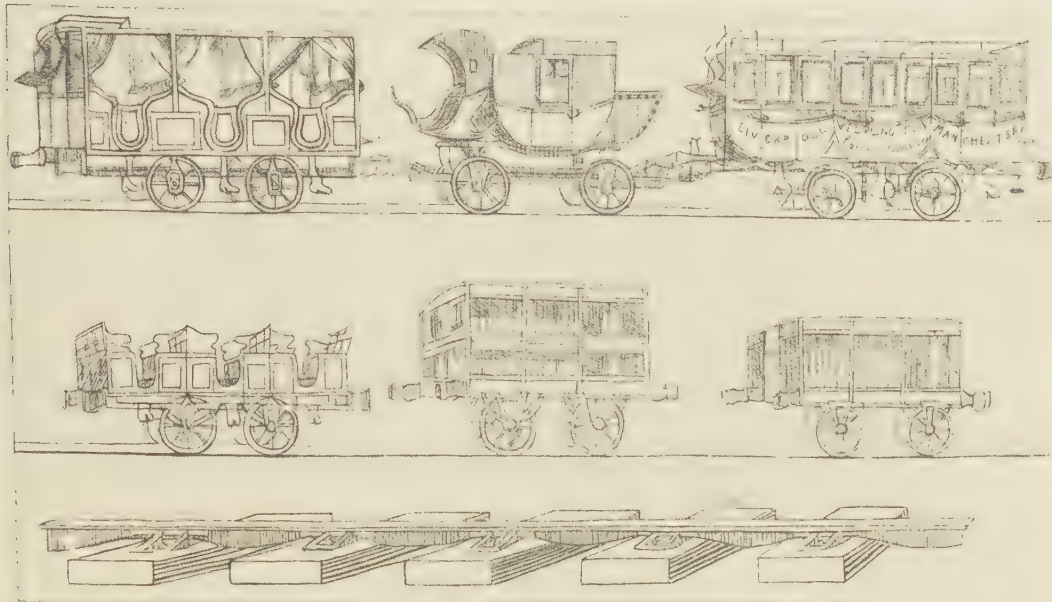
SEE PAGE 78

PLATE XIX

THE FIRST CARRIAGES.

end, and the rail which supports the back so contrived that it may be turned over, so that the passengers may face either way, and the machine does not require to be turned.

Another, three years later³, says:



CARRIAGES.

Employed for the convenience of Passengers and Cattle upon the Railway and offshoots of the Road

Lithograph by Crane.

The passage-carriages are divided into three classes; and are made to resemble four coach bodies joined together on one frame. Those of the first class contain seats for eighteen passengers, three abreast, each seat being separated by arms and numbered. Those of the second class carry twenty-four passengers, four abreast, and have the seats likewise separated and numbered. The third class are open carriages, containing seats for twenty-four passengers. Each train of carriages is attended by one or more guards, who have seats on the outside.

At first the third class carriages closely resembled modern cattle trucks, except that they were not provided with the luxury of a roof. The long print published by Ackermann in its 1831 state shows the passengers standing, in square boxes divided in the middle. In the 1833 state, some of the vehicles

³ 'The Railway Companion,' 1833.

AN EARLY TIMETABLE.

are similar, but without the central opening, and with the addition of canopies. The last two show a great improvement, being much like chars-a-banc, with six rows of seats⁴.

Some writers call the three classes mails, first and second. The trains were also classed as first and second, the latter being those which included open carriages; but altogether there is some little ambiguity as to the exact use of the terms.

The fares given in 'Bradshaw' for 1840 and 1842 are as follow: First class train, 4 inside, royal mail, 6/6; ditto, 6 inside, glass coach, 6/-. Second class train, glass coaches, 6/-; ditto, open carriages, 4/6.'

The 'container' system was used to some extent for coals, two receptacles to a truck; but was soon found unsatisfactory and abandoned⁵.

At late as 1845 the average weight of the passenger trains was stated by Woods to be only about 35 tons⁶.

The following is a copy of one of the earliest time-tables. It is contained in a pamphlet of 12 pages, entitled:

Liverpool and Manchester Railway Travelling, with an account of the times of Departure and Arrival of the Different Trains, Fares, &c., &c.

Also Lists of the Coaches from Liverpool, Manchester and Chester to various parts of the Kingdom, and of the Steam Packets from Liverpool to Ireland, Scotland, Wales, and different parts of the coast.

Printed by E. Smith and Co., Lord Street, Liverpool.

When it came to the point, they appear to have considered it more prudent not to tie themselves down to any times of arrival, which are not indicated. Except for the note about the Bolton line, the whole of the railway information is on one page, in excruciatingly minute type.

⁴ On some railways the primitive form survived for a long time, as in a book called 'The Lancashire and Yorkshire Railway,' by Thomas Mornington, a railwayman of long service, the following account of a journey in 1845 on the Manchester and Leeds Railway occurs: 'I travelled in a passenger wagon train in a stand-up carriage. This carriage was simply a square wood box or wagon, without seats or roof, exposed to all sorts of weather, and the passengers all wedged in, like cattle in a truck.' He gives an illustration of vehicles similar to those in Ackermann's issue of 1831. They were sometimes called 'Stanhopes' (Whishaw, p. 266).

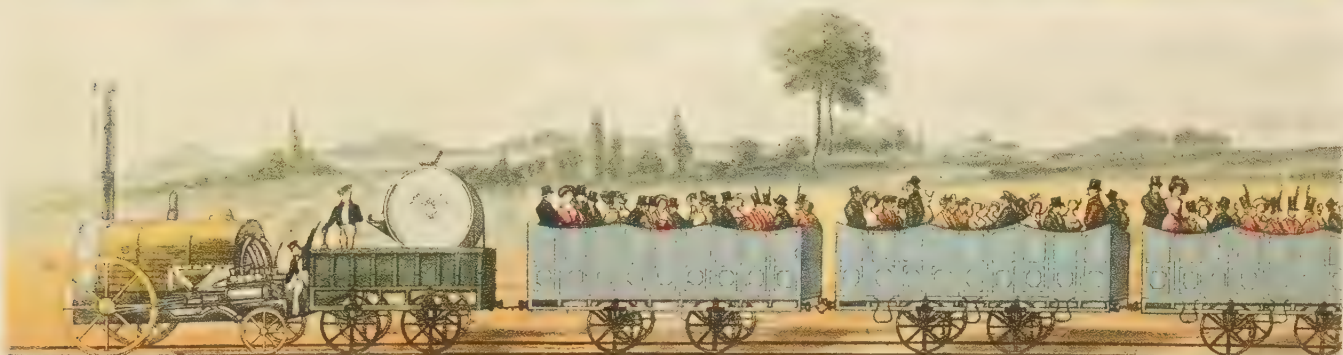
⁵ Gauge Commissioners' Report, 1845; questions 1128-31 and 5939-43.

⁶ Ibid., question 5879.

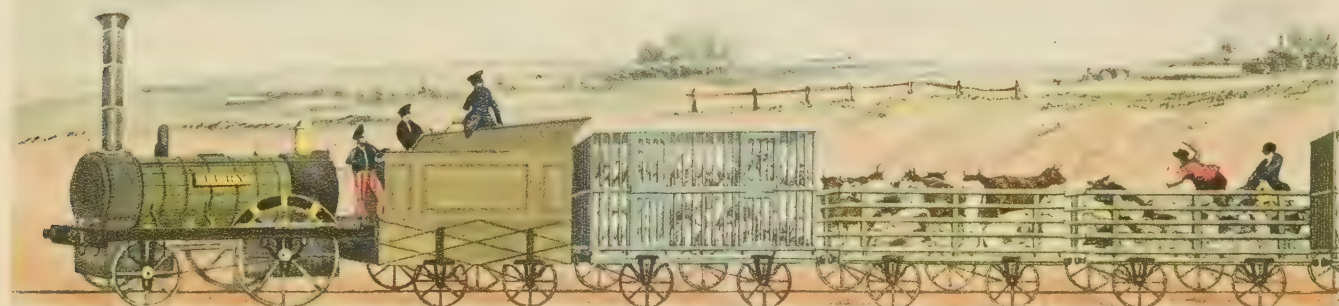
A Train of the First Class of Carriages, with the Mail.



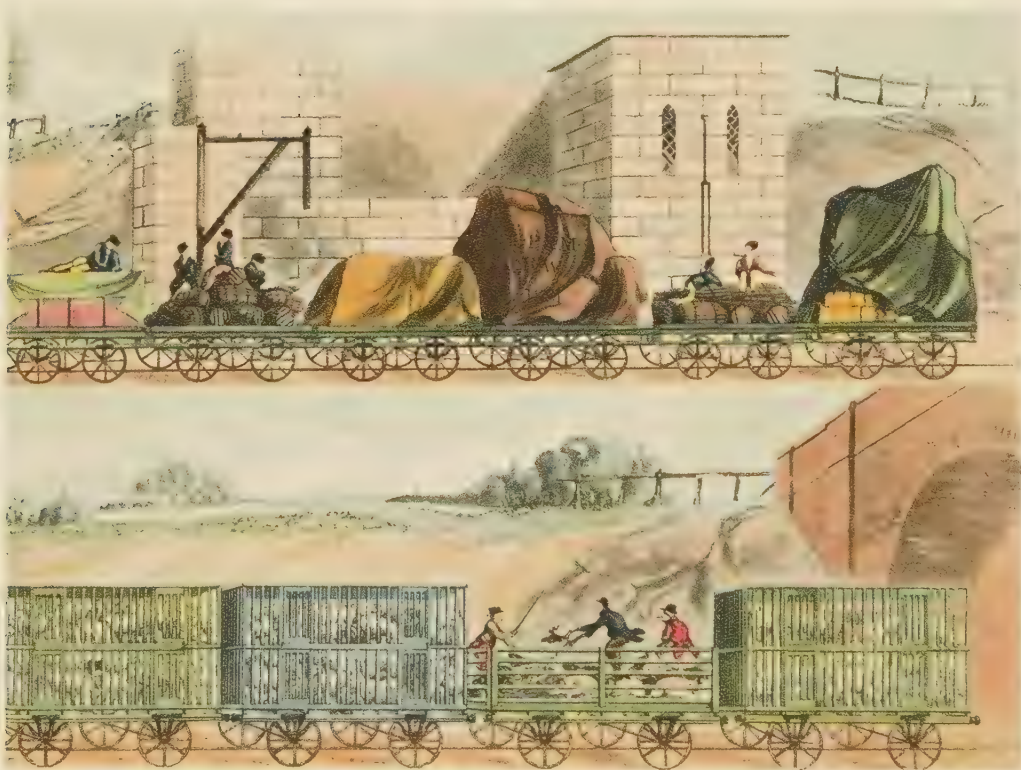
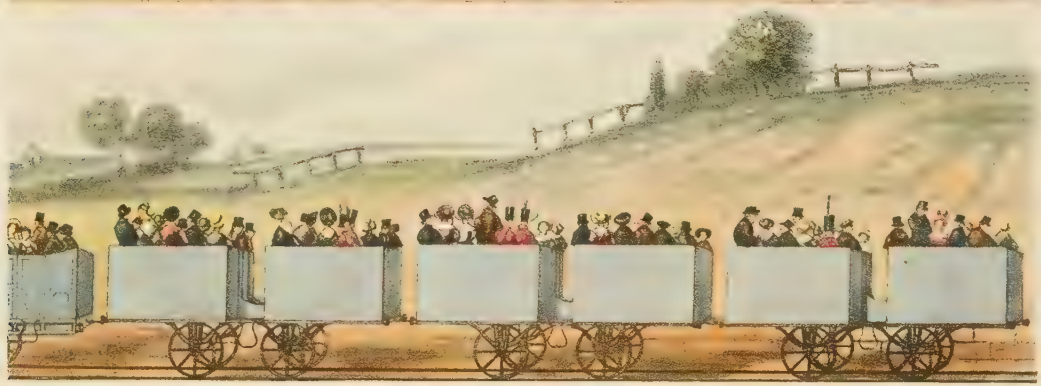
A Train of the Second Class, for outside Passengers.



A Train of Waggon, with Goods, etc., etc.



A Train of Carriages with Cattle.



AN EARLY TIMETABLE.

TRAVELLING BY THE LIVERPOOL AND MANCHESTER RAILWAY.

(For Railway Travelling to BOLTON see last page.)

THE DIRECTORS beg leave to inform the Public that on and after Tuesday, the 1st of March next the several Trains of Carriages will start from the Station in Crown-street, Liverpool, and from the Station in Liverpool-road, Manchester, in the following order:—

HOURS OF DEPARTURE.

Seven o'clock.....First Class Train,	Two o'clock.....First Class Train,
Half-past Seven o'clock...Second Class Train,	Five o'clock.....First Class Train,
Ten o'clock.....First Class Train,	Half-past Five o'clock...Second Class Train.
One o'clock.....Second Class Train,	

N.B.—This last train, on the Manchester market days (Tuesdays and Saturdays) will leave Manchester at Six o'clock instead of Half-past Five.

SUNDAY.

Seven o'clock.....Second Class Train,	Five o'clock.....First Class Train,
Eight o'clock.....First Class Train,	Six o'clock.....Second Class Train.

FARES.

By First Class Train, Coaches, Four	By Second Class Train, Glass Coaches 5s. 0d.
Inside 6s.	„ Ditto, Open Carriages 3s. 6d.
„ Ditto, Ditto Six Inside..... 5s.	

The want of a superior description of Carriage, at a higher fare, having been frequently represented to the Directors, they have caused one Four inside Coach, in each First Class Train, to be fitted up in a superior style, for which an extra charge of 2s. is made.

SHORT FARES.

FROM LIVERPOOL.	First Class.	Secd. Class.	FROM MANCHESTER.	First Class.	Secd. Class.
	s. d.	s. d.		s. d.	s. d.
Wavertree Lane	1 6	1 0	Cross-Lane	1 6	1 0
Broad Green	1 6	1 0	Eccles	1 6	1 0
Roby Gate	1 6	1 0	Patricroft	1 6	1 0
Huyton Gate	1 6	1 0	Bury Lane and Reid's Farm	2 0	1 6
Kendrick's Cross Gate	2 0	1 6	Kenyon Junction	2 6	2 0
Top of Sutton Incline	2 6	2 0	Park Side	3 0	2 0
Bottom of Ditto	2 6	2 0	Newton Bridge	3 0	2 6
Collin's Green	2 6	2 0	Viaduct	3 6	2 6
Viaduct	3 0	2 6	Collin's Green	3 6	2 6
Newton Bridge	3 0	2 6	Bottom of Sutton Incline	3 6	2 6
Park Side	3 0	2 6	Top of Ditto	4 0	2 6
Kenyon Junction	3 6	2 6	Kendrick's Cross Gate	4 0	3 0
Bury Lane and Reid's Farm	4 0	2 6	Huyton Lane Gate	4 6	3 0
Patricroft	4 6	3 0	Roby Lane Gate	4 6	3 6
Eccles	5 0	3 6	Broad Green	5 0	3 6
Cross-Lane Bridge	5 0	3 6	Wavertree Lane	5 0	3 6

BOOKING.

In order to insure punctuality in the times of starting, which has frequently been prevented by Persons claiming to be booked, even after the appointed time of departure, no Passenger, *unless previously booked*, will be admitted into the outer door of the Railway Stations after the clock has struck the hour of departure; and Passengers too late to take their Seats, or otherwise prevented going, may receive back half the fare paid, if claimed not later than the day after that for which the places were booked.

STOPPING PLACES.

With a view to obviate, in some measure, the inconvenience caused by the frequent stoppages to take up and set down Passengers on the Road, all short Fares, excepting those of Newton Bridge, will, in future be taken only by the *Second Class Trains*, namely, at Half-past Seven o'Clock, One o'Clock, and Half-past Five o'Clock, to which will be attached one or more Glass Coaches, by which Passengers may also book through to Manchester. The First Class Trains are intended to make one stoppage only on the journey, namely at Newton Bridge, for the purpose of oiling and examining the machinery; as the stoppage will be very short, and as the Directors are determined, by every means in their power, to prevent the practice

AN EARLY TIMETABLE.

of supplying liquor, &c., on the road, Passengers are particularly requested not to alight.—The Second Class Trains will stop at any of the places named in the list of Short Fares, but to avoid delay, Passengers are requested to have the money ready to pay to the Guard.

OMNIBUSES.

Omnibuses, free of charge to all Passengers at the Liverpool End, and to all Passengers by the FIRST CLASS TRAINS at the Manchester End, leave the Coach Office, Dale-st., Liverpool, half an hour before, and the Coach Office, Market-street, Manchester, twenty minutes before the time appointed for the departure from the respective Railway Stations. The Routes, which will be strictly adhered to, are, at the

LIVERPOOL END.—FIRST ROUTE.—Dale Street, Sir Thomas's Buildings, Williamson-square, Clayton-square, Ranelagh-street, Mount Pleasant, Oxford-street.

SECOND ROUTE.—Dale-street, North John-street, Lord-street, Church-street, Bold-street, Leece-street, Hope-street, Falkner-street.

THIRD ROUTE.—Dale-street, Manchester-street, Lime-street, London-road, Seymour-street, Russel-street, Clarence-street, Mount Pleasant, Oxford-street.

MANCHESTER END. FIRST ROUTE.—Liverpool-road, Water-street, Quay-street, Deans-gate, St. Mary's-gate, Market-street.

SECOND ROUTE.—Liverpool-road, Water-street, Bridge-street, Deans-gate, King-street, Pall Mall, Market-street.

THIRD ROUTE.—Liverpool-road, Bridgewater-street, Mosley-street, Market-street.

The Omnibuses will take up or set down at any point in the above-mentioned Routes, but in offering this accommodation, the Company cannot engage to *call* for any Passenger at a particular place in the Route, nor to *secure* room in the Omnibus, after it has once set out from the Coach Office.

LUGGAGE.

The weight allowed for each Passenger is 60 lb. beyond which a charge will be made at the rate of 3s. per cwt.

PORTERS.

The Company engages to load and unload Passengers' Luggage, upon and from the Railway Carriages and Omnibuses, and to deposit it in any of the Coach-offices, free of charge, for any service in addition to this the Porters are allowed to make a reasonable charge.

GUARDS.

No gratuity is allowed to be taken by any Guard, Engine-man, Porter, Omnibus Driver, or other servant of the Company.

SMOKING.

No smoking will be allowed in any of the First Class Carriages, even with the general consent of the Passengers present, as the annoyance would be experienced in a still greater degree by those who may occupy the same coach on the succeeding journey.

Railway Office, Liverpool, Feb. 20, 1831.

The information at the end about the Bolton Railway is as follows:

TRAVELLING TO BOLTON BY THE RAILWAY.

The Bolton and Kenyon Railway being completed, Passengers and Parcels may be booked for Bolton at the Railway Office, Dale Street, Liverpool. Hours of departure from the Railway Station, in Crown-Street, are Half-past ten in the Forenoon, and Six o'clock in the Afternoon, every day, except Sundays.

Fares—Inside 5s. Outside 3s. 6d. including the Omnibus.
No extra charge.



NEW STATION, LIME STREET.
ENTRANCE TO THE TUNNEL, BOOKING OFFICES, ETC.



EDGE HILL STATION.
END OF THE TUNNEL.

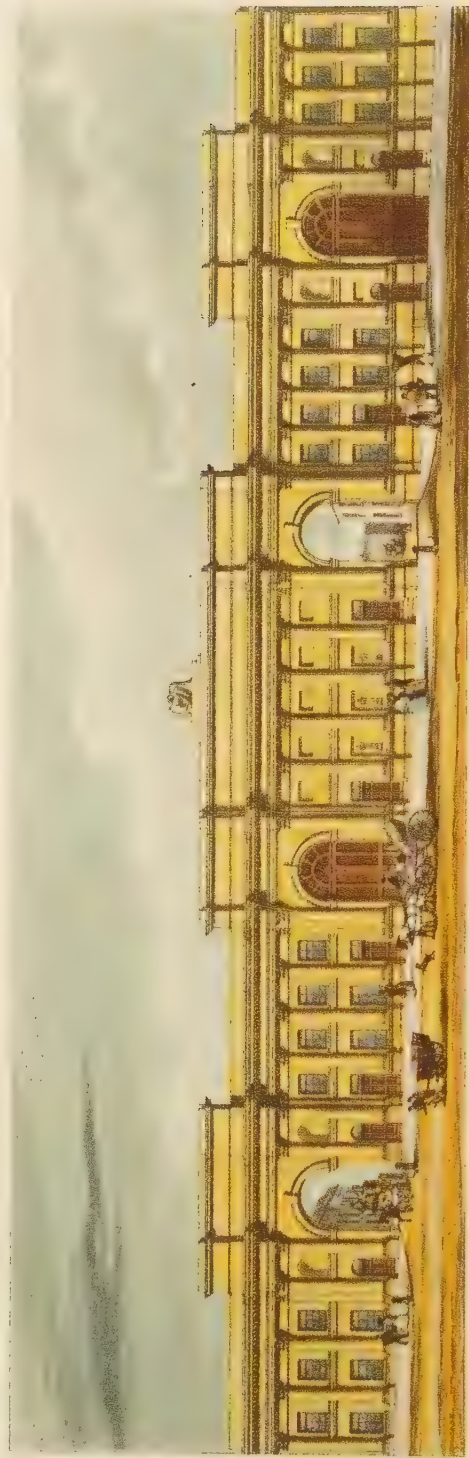


PLATE XXI.

NEW GRAND ENTRANCE TO THE LIVERPOOL AND MANCHESTER RAILWAY, LIME STREET, LIVERPOOL.

ACKERMANN'S PRINT OF 1836.

To face page 71.

NEW STATIONS.

The arrangements at Liverpool, which had been designed so as to disarm opposition by keeping the railway as little in evidence as possible, were inadequate and inconvenient, and a new large station was built at Lime Street, where the station is now. It was completed August 15th, 1836, being approached by a fresh tunnel; since almost entirely opened up. The Common Council of Liverpool contributed £2,000 out of the town's funds towards the architectural decorations. At the same time, a new station was made at Edgehill, a little farther away than before. Two beam engines, with cylinders 25 by 72 inches, built by Mather Dixon and Co., were used, one as a stand-by⁷.

For the first six months of 1831, a dividend of £4 10s. od. per cent. was paid. The shares soon rose to 200. For the half-year ending June, 1845, the dividend was £5. Tuck's 'Railway Shareholders' Manual' for 1846 shows that since 1839 the shares had varied between 182 and 231. It also states that the company had purchased the Bolton and Leigh Railway and Kenyon Extension line, and had amalgamated with the North Union and Grand Junction Railways, in fact, it became part of the latter.

On July 16th, 1846, a Bill received the Royal Assent for the amalgamation of the London and Birmingham, Grand Junction, and Manchester and Birmingham lines, which formed the London and North-Western Railway. In the volume of 'Tuck' just referred to, it is called the 'Great London and Liverpool Railway.'

Signalling was at first entirely done by hand. The 'Railway Companion' (1833) says:

The Company keep a police establishment who have station-houses at intervals of about a mile along the road. These stations form also depôts for passengers and goods from or to any of the intervening places. The duties assigned to these men are to guard the road—to prevent or give notice of any obstruction,—and to render assistance in the case of any accident occurring; and to do this effectually they keep up a continual line of communication. When a train approaches within a certain distance of a station, the policeman presents himself, and signifies a clear road by assuming an erect position with his arm outstretched: should he take the position of 'stand at ease,' the engineer is aware that some obstruction exists⁸. When a passenger is waiting at a station a red flag is hoisted by day,

⁷ Whishaw's 'Railways of Great Britain and Ireland,' p. 193.

⁸ One would have expected the opposite. . Perhaps there is a mistake.

SIGNALLING.

and a swinging lamp exhibited at night. In travelling in the dark the last carriage of every train carries 'astern'—to use a nautical expression—a revolving lamp, one side of which is red, the other blue. As long as the train is in motion the red light presents itself to whatever follows, but at the instant of stopping, the blue light is turned outward; the engineer of the next train instantly sees this change, and is enabled, by checking the velocity of his engine, to avoid a collision that would be tremendous. The fire of the engine is sufficient to give warning to the policeman or to any object upon the road of the approach of a train.

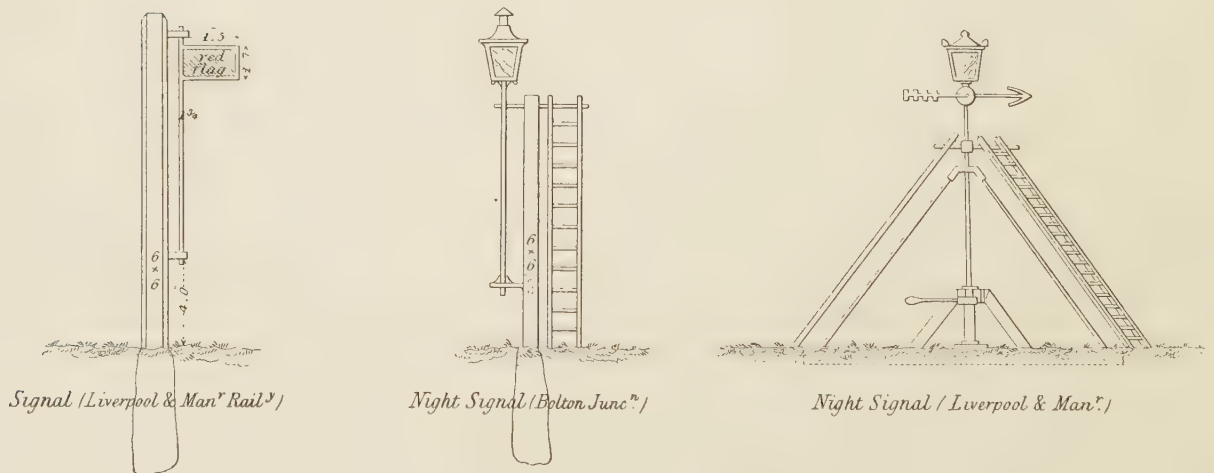
It is probable that the policemen were supplied with beautifully embellished truncheons, as the author's collection contains several, belonging to various early railways, but he has never come across one of the L. and M.R.

About 1838 pivoted boards were introduced for use in the daytime, being turned across, or parallel to the track, according to whether the line was blocked or clear. It was assumed to be the latter five minutes after the passage of a train; measured by sand-glasses, known to the men as 'egg-boilers.'

Plate XXII shows the seal of the Locomotive Department used during the latter years; a complimentary and a director's pass; and one of the earliest passengers' tickets.

In 1845 the speed of the express trains was given as 31 miles in 45 minutes⁹.

⁹ Gauge Commissioners' Report, Vol. II, p. 514.



From Whishaw's 'Railways of Great Britain and Ireland,' 1840.



J. P. Carter, Esq.,

No. 1832.		Liverpool to Warrington.	
Passenger.		at o'Clock from Railway Station.	
Paid		Agent.	
Amount		This Ticket must be shown at the Station, but must be kept to present to the Guard of the Warrington Coaches at Warrington Junction. (Turn over.)	

Chapter IX

THE LOCOMOTIVES: THE REGULAR STOCK.

THE engines of this railway present a most interesting study in the evolution of design, and the author has spared no pains in searching every likely source of information on the subject. Three lists are available: one in Whishaw's 'Railways of Great Britain and Ireland,' 1840; one in the Gauge Commissioners' Report of 1845; and an old manuscript one which has been given to the author by Sir John Dewrance, K.B.E., who is a son of the last Locomotive Superintendent of the line. The London, Midland and Scottish Railway have very kindly made extracts from the Directors' minutes of all matters relating to locomotives, many of which are reproduced here. Some of the information was also furnished by the late Mr. E. L. Ahrons.

The first locomotive superintendent was John Dixon. A minute of 2nd December, 1833, is as follows:

An additional superintendent on the road under Mr. Dixon having become necessary . . . the Treasurer was authorised to enter into an agreement with Mr. Edward Woods, a young man recommended by Mr. John Cropper, for a term of 4 years . . . Mr. Woods to be at this end of the line, and . . . Mr. John Forsyth, now under Mr. Dixon, at the Manchester end.

29th September, 1836.

A discussion took place as to supplying Mr. Dixon's place in the Engineering Dept. and the Committee were of opinion that it would be expedient to make an engagement with Mr. Woods as principal Engineer for a term of 3 years, to reside at Manchester, and to agree with Mr. William Buddicom¹ for two years as assistant at the Liverpool end.

¹ Buddicom afterwards went to the Grand Junction, and later to the Paris and Rouen Railway; also establishing a locomotive factory in France.

THE LOCOMOTIVE SUPERINTENDENTS.

John Melling is mentioned in 1833 as being Superintendent of the repairs of the locomotives at the Birchfield Station (Manchester).

Minute of 8th May, 1837:

Read a letter from Mr. Melling, renewing his application for an Increase of Salary. After discussion it was agreed that it would be advisable to concentrate the Repairing Establishments at Liverpool by removing or very much reducing the Establishment at Manchester . . . Mr. Thos. Melling² having entered the service of the Grand Junction Company it was agreed that Mr. Melling's salary should be six guineas a week, it being understood that he undertake the superintendence of the whole Locomotive Establishment.

23rd December, 1839.

The Chairman . . . was requested to inform Mr. Melling and the Mr. Grays³ at the Liverpool end, and Mr. Fyfe⁴ at Manchester that in consequence of the change it was thought desirable to make in the Management of this Department, their services would not be required after the expiration of three months from the 31st ult.

Melling became an engine-builder at Rainhill, and supplied three engines to the Grand Junction Railway.

John Dewrance was then appointed Locomotive Superintendent and designed a number of engines, known as the ' Bird ' Class, from their names.

Woods' name continues to appear in the minutes as late as 1842; mostly in connection with the Manchester end. In 1845 he stated he had been Chief Engineer to the Company for ten years⁵. He afterwards became President of the Institution of Civil Engineers.

The following list, so far as the numbers and names are concerned, is the one supplied by Sir John Dewrance. The numbers in the first column are those of the railway. For a long time they were always referred to by name. The L.M. and S.R. Co. have a book of 1839-40 containing records of mileage and fuel consumption, with printed columns and headings, a column being provided for names, but none for numbers. Only a single instance is

² John's son, also employed by the railway.

³ Apparently two of them. One, John, afterwards became well known.

⁴ Fyfe was afterwards Locomotive Superintendent of the Northern and Eastern Railway.

⁵ Gauge Commissioners' Report, question 5865.

THE LOCOMOTIVE STOCK.

known to the author of a number being shown in an illustration, but that can be accounted for by their position. The lower engine on the second long print by Ackermann, 'Fury,' shows 21, on the buffer beam, and high up on the front of the chimney. The numbers given in the second column are those allotted to the engines when amalgamated with the Grand Junction stock, and afterwards retained on the L. and N.W.R.

The locomotives belonging to the latter railway were divided into sections, each being numbered independently, until 1861, when they were all brought into one series, those of the Northern division remaining unchanged. The latter were originally as follow :

- 1— 72 Original Grand Junction engines, by various makers.
- 73— 88 Grand Junction Railway engines built at Crewe.
- 89—112 London and North Western engines.
- 113—163 Liverpool and Manchester engines.
- 164—176 L. and N.W.R.
- 177—184 North Union stock.

For many years, as new engines were built for the L. and N.W.R., they were given the old names, associated with the same numbers; sometimes even twice, as time went on.

The letter W means 'included in Whishaw's list of the engines at work in 1840.' G. signifies the list in the Gauge Report, and C, L, J, Coaching, Luggage and Jobbing respectively, being the headings under which they are classified in that list, which is dated 20th June, 1845.

An asterisk draws attention to a second use of the name so indicated.

LIST OF LOCOMOTIVES.

NUMBERS	NAME			DATE		BUILDERS			TYPE	CYLINDERS	REMARKS
1	—	Rocket	.. ..	Oct.	1829	Stephenson	.. ..	0-2-2		8 x 17	Now at South Kensington.
2	—	Meteor	.. ..	Jan.	1830	„	.. ..	„		10 x 16	Sold 1837 for £240.
3	—	Comet	.. ..	„	„	„	.. ..	„		„	Sold by 1836.
4	—	Arrow	.. ..	„	„	„	.. ..	„		„	Sold 1840 for £50.
5	—	Dart	.. ..	Feb.	„	„	.. ..	„		„	Broken up by 1836.
6	—	Phoenix	.. ..	June	„	„	.. ..	„		11 x 16	„
7	—	North Star	.. ..	Aug.	„	„	.. ..	„		„	Sold Dec., 1833, for £275.

THE LOCOMOTIVE STOCK.

NUMBERS	NAME	DATE	BUILDERS	TYPE	CYLINDERS	REMARKS
8	Northumbrian	Aug. 1830	Stephenson	0-2-2	11 x 16	'Done with' by 1836.
9	Planet	Oct. "	"	2-2-0	"	W.
10	Majestic	Nov. "	"	0-2-2	"	'Done with' by 1836.
11	Mercury	Jan. 1831	"	2-2-0	"	W.
12	Mars	"	"	"	"	'Done' by Apr. 1833.
13	Samson	Feb. "	"	0-4-0	14 x 16	"
14	Jupiter	"	"	2-2-0	11 x 16	"
15	Goliath	Mar. "	"	0-4-0	14 x 16	Sold by 1836.
16	Saturn	Apr. "	"	2-2-0	11 x 16	'Done' by Apr., 1833.
17	Sun	"	"	"	"	" (sold by 1836)
18	Venus	"	"	"	"	"
19	Vulcan	May "	Fenton, Murray	"	"	W.
20	Etna	June "	Stephenson	"	"	'Done' by 1833, sold by 1836.
21	Fury	Aug. "	Fenton, Murray	"	"	W.
22	Victory	Sep. "	Stephenson	"	"	"
23	Atlas	Oct. "	"	0-4-0	12 x 16	" Rebt. 1842 as No. 81.
24	Vesta	Nov. "	"	2-2-0	11 x 16	"
25	Milo	Mar. 1832	"	0-4-0	12 x 16	"
26	Liver	Apr. "	Bury	2-2-0	11 x 16	Sold 1837 for £700.
27	127 Pluto	Aug. "	Stephenson	"	12 x 16	W. G-C. Rebt. 1841.
28	Caledonian	"	Galloway	0-4-0	"	Sold May, 1837, for £400.
29	Ajax	Nov. "	Stephenson (29)	2-2-0	11 x 18	W.
30	Leeds	Jan. 1833	Fenton, Murray	"	11 x 16	" Sold 1840 for £414/2/2.
31	Firefly	Mar. "	Stephenson (30)	"	11 x 18	"
32	Experiment	"	Sharp, Roberts (A)	"	13½ x 16 ?	Sold Dec., 1836, for £500.
33	Patentee	1834	Stephenson (37)	2-2-2	11 x 18	W.
34	Titan	Sep. "	Tayleur (8)	0 4-0	11 x 20	" Aftds. 0-4-2.
35	Orion	Oct. "	" (9)	"	"	"
36	Swiftsure	"	Forrester	2-2-0	11 x 18	" Aftds. 2-2-2.
37	Rapid	Dec. 1835	Tayleur (17)	2-2-2	12 x 18	"
38	Speedwell	"	" (19)	"	"	"
39	Hercules	"	Mather, Dixon (32)	0-4-2	15 x 16	"
40	Eclipse	"	Tayleur (29)	0-4-0	12 x 18	" 0-4-2 by 1840.
41	124 Star	Feb. 1836	" (30)	2 2-0	14 x 12	" G-J. Aftds 2-2-2.
42	York	Jan. "	" (31)	0-4-2	12 x 18	"
43	125 Vesuvius	Feb. "	Haigh Foundry	2-2-2	12½ x 16	" G-J.
44	Thunderer	"	Mather, Dixon (33)	0-4-2	15 x 16	"
45	114 Lightning	June "	Haigh Foundry	2-2-2	12½ x 16	" G-C.
46	Cyclops	"	"	"	"	"
47	Milo*	Nov. "	Tayleur (32)	"	14 x 12	"
48	Dart*	Dec. "	Mather, Dixon	"	"	"
49	Phoenix*	"	Tayleur (33)	"	"	"
50	Majestic*	"	" (46)	"	"	"
51	Etna*	Jan. 1837	" (47)	"	"	"
52	Arrow*	Feb. "	Mather, Dixon (35)	"	"	"
53	Sun*	Mar. "	Hawthorn (213)	"	"	"
54	115 Meteor*	"	Mather, Dixon (36)	"	"	" G-C.
55	Comet*	"	" (37)	"	"	"
56	Vesta*	"	Hawthorn (214)	"	"	"

THE LOCOMOTIVE STOCK.

NUMBERS	NAME	DATE	BUILDERS	TYPE	CYLINDERS	REMARKS
57 116	Lion .. .	1838	Todd, K. & L. (1)	0-4-2	12 x 18	W. G-L. Has survived.
58 117	Tiger .. .	"	" (2)	"	"	" "
59 123	Rokeby .. .	"	Rothwell .. .	2-2-2	11 x 18	" G-J.
60 118	Roderic .. .	"	" .. .	"	"	" G-C.
61 —	Mammoth .. .	1839	Banks .. .	0-4-2	12 x 18	"
62 —	Leopard .. .	"	Todd, K. & L. .. .	2-2-2	11½ x 18	"
63 119	Mastodon .. .	"	Banks .. .	0-4-2	12 x 18	" G-J. Rebt. 1841.
64 —	Panther .. .	"	Todd, K. & L. .. .	2-2-2	11½ x 18	"
65 113	Elephant .. .	"	" .. .	0-4-2	14 x 20	" G-L.
66 120	Samson* .. .	"	Hick .. .	"	11 x 20	" G-J.
67 121	Buffalo .. .	"	Todd, K. & L. .. .	"	14 x 20	" G-L.
68 122	Goliath* .. .	"	Hick .. .	"	11 x 20	" G-J.
69 128	Swallow .. .	Sep. 1841	L. & M. R. .. .	2-2-2	12 x 18	G-C.
70 129	Martin .. .	Jan. 1842	" .. .	"	"	"
71 131	Kingfisher .. .	Sep. 1841	" .. .	"	"	"
72 130	Heron .. .	Nov. "	" .. .	"	"	"
73 132	Pelican .. .	Dec. "	" .. .	"	"	"
74 133	Ostrich .. .	Mar. 1842	" .. .	"	"	"
75 134	Owl .. .	"	" .. .	2-4-0	13 x 20	G-L.
76 135	Bat .. .	June "	" .. .	"	"	"
77 136	Stork .. .	May "	" .. .	2-2-2	12 x 18	G-C.
78 137	Crane .. .	Oct. "	" .. .	"	"	"
79 138	Swan .. .	"	" .. .	"	"	"
80 139	Cygnets .. .	Dec. "	" .. .	"	"	"
81 140	Atlas* .. .	Nov. "	" .. .	0-4-2	"	G-J. (A rebuild).
82 141	Pheasant .. .	Jan. 1843	" .. .	2-2-2	"	G-C.
83 126	Partridge .. .	June "	" .. .	"	"	"
84 142	Bittern .. .	Apr. "	" .. .	2-4-0	13 x 20	G-L.
85 143	Lapwing .. .	Oct. "	" .. .	"	"	"
86 144	Raven .. .	Dec. "	" .. .	"	"	"
87 145	Crow .. .	Jan. 1844	" .. .	"	"	"
88 146	Redwing .. .	Mar. "	" .. .	2-2-2	12 x 18	G-C.
89 147	Woodlark .. .	"	" .. .	"	"	"
90 148	Penguin .. .	Jan. 1845	" .. .	2-1-0	13 x 20	G-L.
91 149	Petrel .. .	July 1844	" .. .	"	"	"
92 150	Linnet .. .	1845	" .. .	2 2-2	12 x 18	G-C.
93 151	Goldfinch .. .	"	" .. .	"	"	"
94 152	Bullfinch .. .	"	" .. .	"	"	"
95 153	Chaffinch .. .	June "	" .. .	"	"	"
96 154	Starling .. .	July "	" .. .	"	"	"
97 155	Owzell .. .	1845-6	" .. .	"	"	"
98 156	Redstart .. .	"	" .. .	"	"	"
99 157	Redbreast .. .	"	" .. .	"	"	"
100 158	Condor .. .	"	" .. .	2-2-2	"	"
101 159	Adjutant .. .	"	" .. .	"	"	"
102 160	Flamingo .. .	"	" .. .	"	"	"
103 161	Cuckoo .. .	"	" .. .	"	"	"
104 162	Albatross .. .	"	" .. .	"	"	"
105 163	Osprey .. .	"	" .. .	"	"	"

THE FIRST LOCOMOTIVES.

Whishaw's list of 1840, so far as it goes, coincides, with but one exception. His last engine is 69 'Victoria,' by Mather, Dixon and Co.; the arrangement and sizes of the wheels being confused. This engine does not appear in the Gauge Report, and probably went to some other railway.

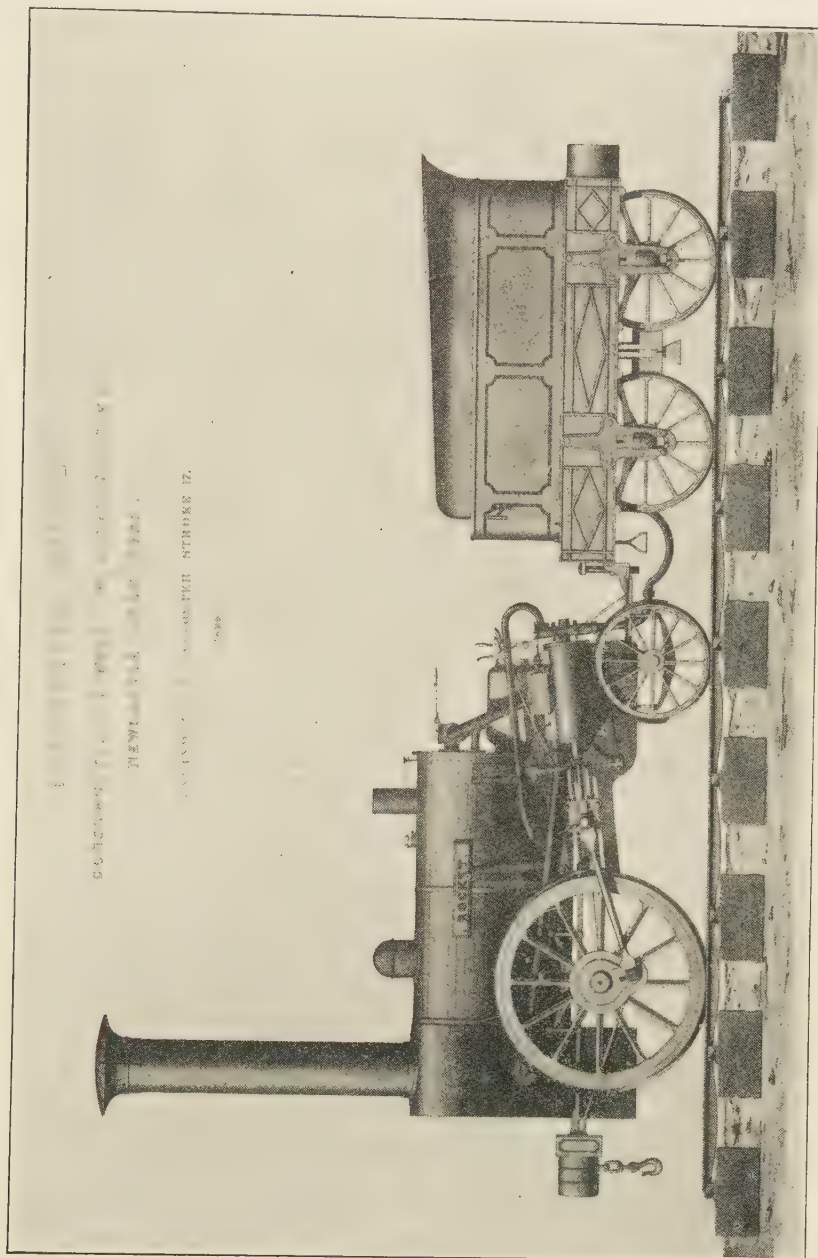
The 'Rocket' has already been sufficiently described. A curious incident in her career was an experiment made in 1834 with a view to applying Lord Dundonald's rotary engine to her, but it appears from the Minutes that they were abandoned after about £80 had been expended. There is no mention of this episode in the 'Life of Lord Dundonald,' nor can any traces of the work be found on the engine. An article with a very full account of her history appeared in *The Locomotive* for November, 1907; vol. xiii, p. 201.

In 1929, what is as nearly as possible an exact replica of her as first built was produced by Robert Stephenson and Co., to the order of Mr. Henry Ford. See Plate XIX. A description of it, with detail drawings, was given in a most interesting article in *The Engineer* for 31st May, 1929.

The fast running of the 'Rocket' at Rainhill brought out the unsteadiness produced by her steeply-inclined cylinders, and in the rest of the class, Nos. 2 to 8 and 10, they were placed nearly horizontal. It is probable that she was thus altered during the period of nearly a year between the competition and the opening.

In 1836, when the directors decided to sell her, they ordered that 'a good drawing should be made of her to exhibit the form and construction of the first engine employed on the Rail Way,' which is probably the one shown opposite, the original of which has been at Crewe for many years.

The detached firebox was retained down to No. 7 'North Star,' also the truck-and-barrel tender; the 'Northumbrian' being the first to have a firebox integral with the boiler, and a respectable tender. It is also probable that she had the first smokebox. From several representations of the engine, e.g. *Mechanics' Magazine*, 16th October, 1830; Alderson's 'Essay on Steam,' 1834; *The Engineer*, 7th November, 1884, and a jug showing the opening procession (see Plate XXVII) one would infer that the first form was square in cross section; but this possibility seems to be negatived by a sketch of Nasmyth's, which will be dealt with directly.



THE ROCKET.
(After having been rebuilt).



THE 'NORTHUMBRIAN.'

The upper illustration on the opposite page is taken from the *Mechanics' Magazine*; the lower one being a reproduction of Shaw's etching No. 4. The latter shows a central buffer at the back of the tender.

The locomotive literature of the fifties and sixties contains records of any number of clumsy and complicated designs of firebox, produced in the attempt to burn coal without making smoke, and it is very remarkable that the 'Northumbrian' design proved after all to be the right one, and, with the addition of the brick arch, became the standard form.



The engraving entitled 'The Rocket' shown above is of considerable interest. From the tender it is evident that it was sketched from the 'Northumbrian.' The original was drawn by James Nasmyth just before the opening. In his 'Autobiography' he says (on page 157):

I spent the entire day in watching the trial trips, in examining the railway works, and such portion of their details as I could obtain access to. About mid-day the 'Rocket' was at rest for about an hour near where I stood, and I eagerly

THE 'NORTHUMBRIAN' CLASS.

availed myself of the opportunity of making a careful sketch of the engine, which I still preserve.

In *The Engineer* for 12th September, 1884, the original sketch was reproduced. It shows Nasmyth's signature, with the following note in his writing :

The sketch of the 'Rocket' I made at Liverpool on the 12th September, 1830, the day before the opening of the Liverpool and Manchester Railway, while it remained stationary after some experimental trips, in which George Stephenson acted as Engine Driver, and his son Robert as Stoker.

Very likely, as the engine was just new, the nameplate had not been put on, hence the mistake. The chimney stays were evidently removed.



Some of the engines seem to have had a firebox with a sloping back, as shown in the above figure, taken from one of the long Ackermann prints. This form is mentioned by J. S. Walker, in his 'Accurate Description,' where he describes the firebox as 'a small compartment with a sloping front, in the middle of which is the little door by which it is fed with fuel.'

Either the 'Meteor' or the 'Arrow' was at first called 'Wildfire,' as will be seen in the Appendix.

The chimney of the 'Phoenix' had a castellated top. It appears in Shaw's etching of the opening.⁶

⁶ See page 59.

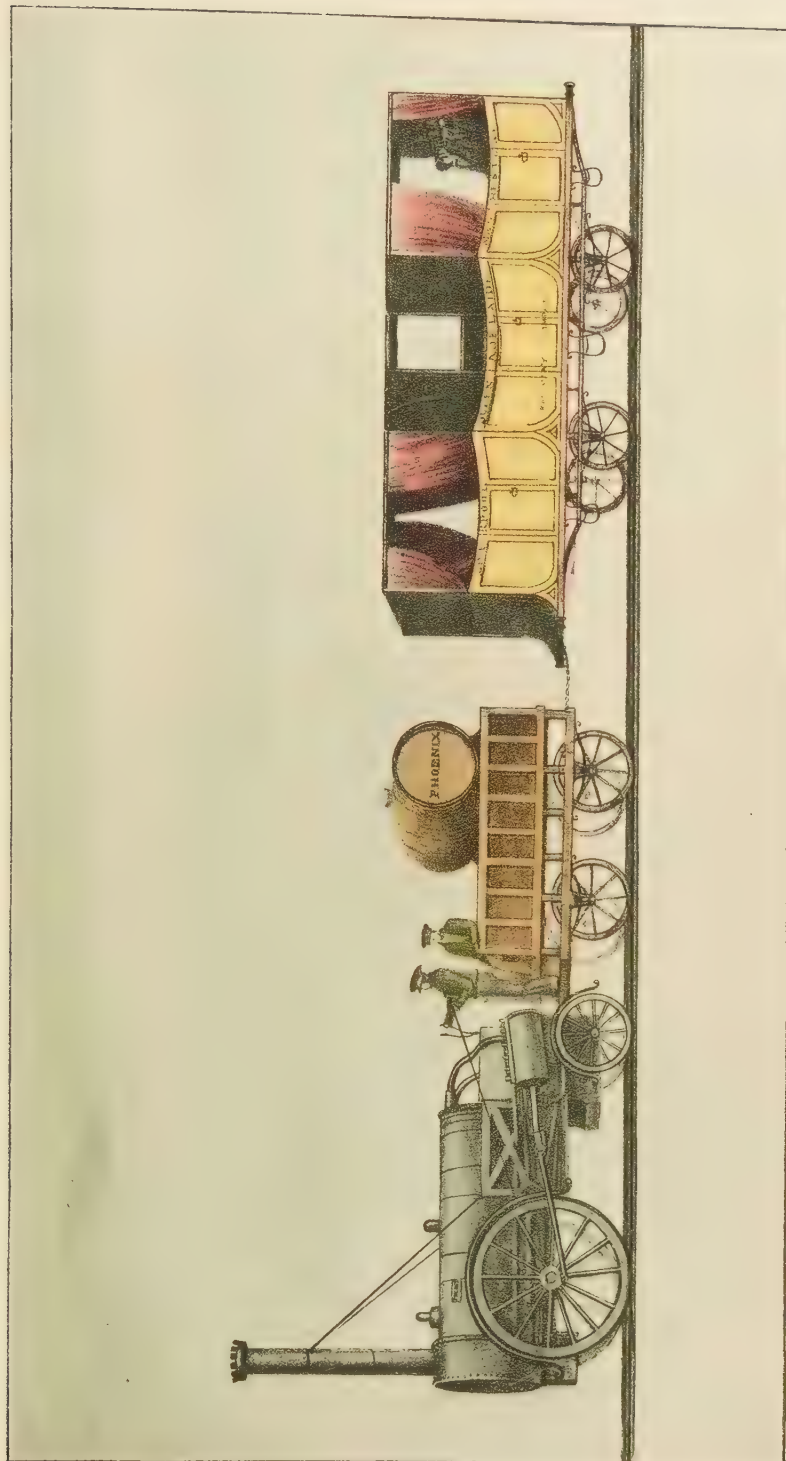
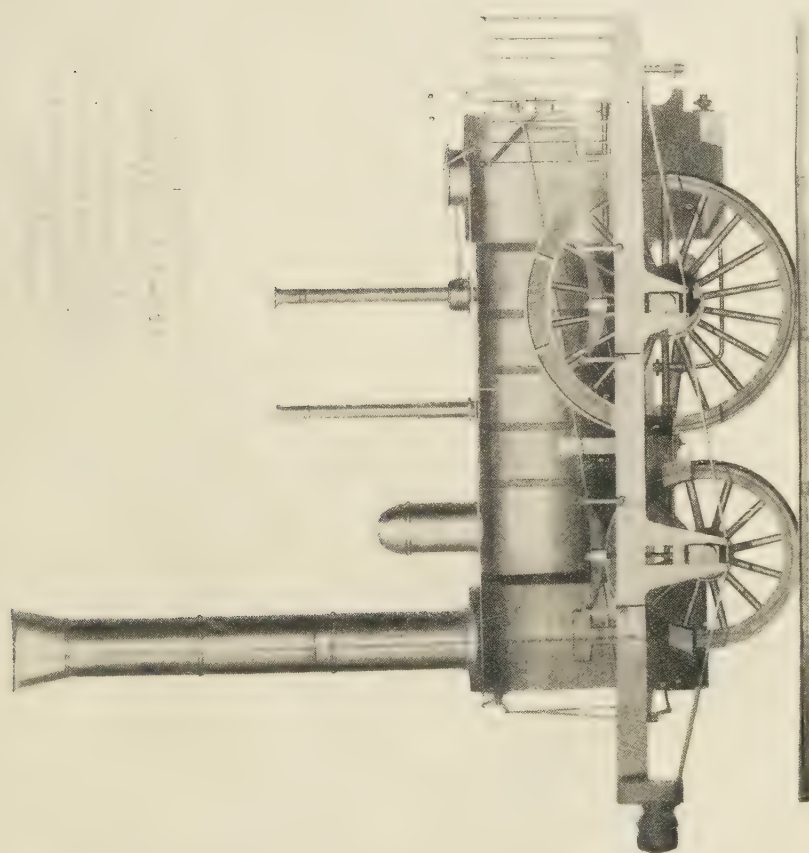
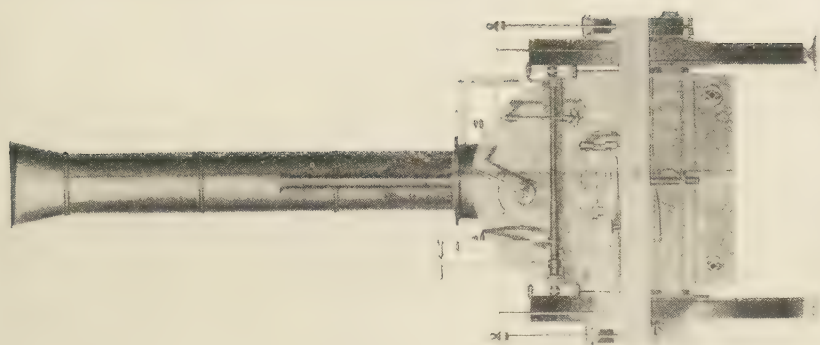
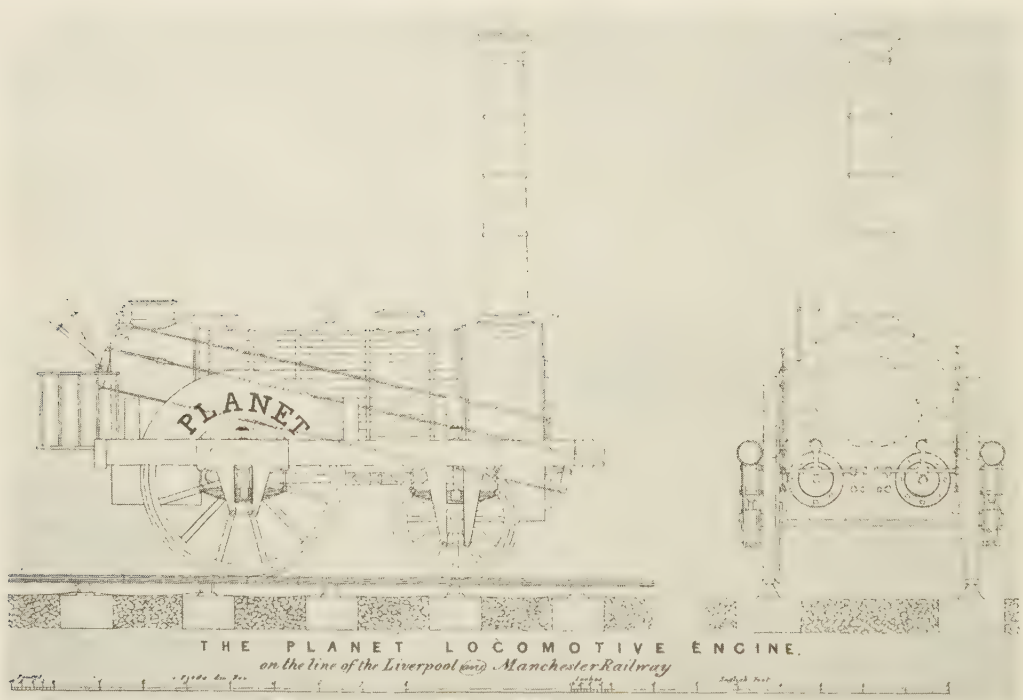


PLATE XXIII.
THE "PHOENIX" LOCOMOTIVE AND CARRIAGE.
FROM CRANE'S LITHOGRAPH.

To face page 82.

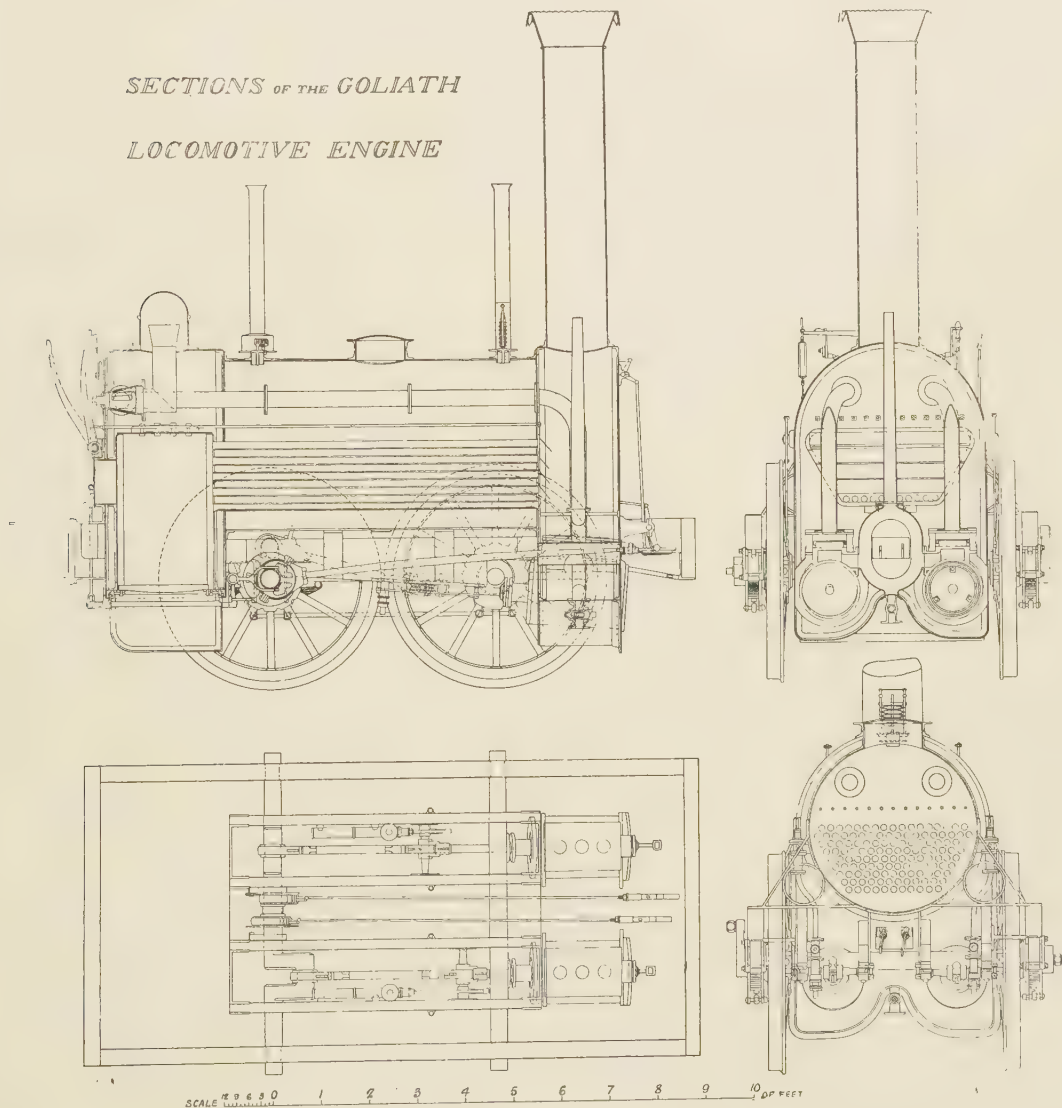


AN ENGINE OF THE 'PLANET' TYPE.



THE 'PLANET.'

The 'Planet' was a great step in advance, the cylinders being inside, at the bottom of the smokebox, with the driving wheels at the rear. This engine has been illustrated in more than one book with the frame passing under the driving axle and over the leading one, a libel based on an old drawing which has survived, but evidently represents a design never carried out. The upper illustration on the opposite page is from Shaw's etching No. 8; the other being a lithograph by G. Smith.



THE LOCOMOTIVE STOCK.

No. 11, 'Mercury,' received the addition of a pair of trailing wheels at the end of 1833; others were also so treated; *e.g.*, 23, 27 etc.

In 1831 a new design appeared, intended for goods traffic, with four coupled wheels, six inches smaller, namely 4 feet 6 ; the cylinders being dropped so as to clear the leading axle. The first two engines were named 'Samson' and 'Goliath.'

No. 18 'Venus,' and probably four other engines, were fitted with Perkins' circulating device. A minute of 3rd December, 1832, calls it 'Perkins' lining to the firebox, for promoting the better circulation of the water.' According to a description in Gordon's 'Elemental Locomotion,' it consisted of a curved sheet in the lower part of the barrel of the boiler, between the tubes and the shell⁷.

Nos. 19 and 21, built by Fenton, Murray and Co., were from Stephenson drawings.

No. 23, 'Atlas,' was afterwards fitted experimentally with an additional pair of wheels which could be lifted off the rails by a steam cylinder. She was also remarkable in having piston valves, the first used on a locomotive. A drawing is given on page 285 of 'A Century.' Since that book was written, a letter has been discovered from Robert Stephenson to F. Swanwick, dated 4th February, 1832, in which it is stated that they were applied to this engine. In 1842 she was 'rebuilt' at a cost of £961, and was numbered 81; probably there was hardly anything left of the original engine.

No. 26, 'Liver,' was the first departure from the Stephenson designs. Bury had been making great efforts to obtain some of the orders, but his ideas were strongly disapproved of by Stephenson. However, in August, 1831, the directors decided to order two engines from him at £730 each, but stipulated that he must depart from his usual practice, and use outside frames. The Bolton and Leigh Railway, being short of locomotives, had just asked if they might be allowed to take over from Stephenson and Co. the next one intended for the L. and M.R., and the request was met by passing one of the Bury engines on to them in April, 1832, named 'Peel'.⁸ In 1836 the 'Liver' was fitted with a double firebox invented by Gray and Chanter, for burning a mixture of coke and coal. In January, 1837, there

⁷ *Op. cit.*, II edn., p. 155, and plate XII.

⁸ Miscalled 'Bee' by Whishaw.

EXPERIMENTS WITH COAL.

was an explosion, severely injuring the enginemen, 'which took place just before the starting of the 10 o'clock Blue train from the top of the tunnel'⁹. A drawing of the firebox is given in Clark and Colburn's 'Recent Practice in the Locomotive Engine,' 1860; page 25. On the 16th October, 1837, the Treasurer reported that he had sold the 'Liver' to Messrs. Mullins and McMahon, contractors on the North Union Railway, for £700.

There are some other interesting minutes relating to attempts to substitute coal for coke in the year 1836 which may be included here:

October 31st:

Read a letter from Mr. Samuel Hall of Basford mentioning that he had taken out a patent for burning smoke in Engines which he would be happy to assist in trying on the Liverpool & Manchester Rail Way. The Treasurer was instructed to enquire the terms on which he would grant the use of his invention, in the event of the Company being disposed to adopt it. It was also ordered that some experiments be tried with one of the Company's Engines with coal for fuel, to ascertain the Comparative Consumption of Coal & Coke.

November 7th.

Read a letter from Mr. Woods detailing some preliminary experiments with Coal in the Fury and Swiftsure engines. The Chimney end of the Fury was a good deal burnt and the joints of the steam pipes injured with excessive heat. Mr. Woods was making some alterations in the Fire Bars to remedy this evil, and would proceed with the experiment.

November 14th.

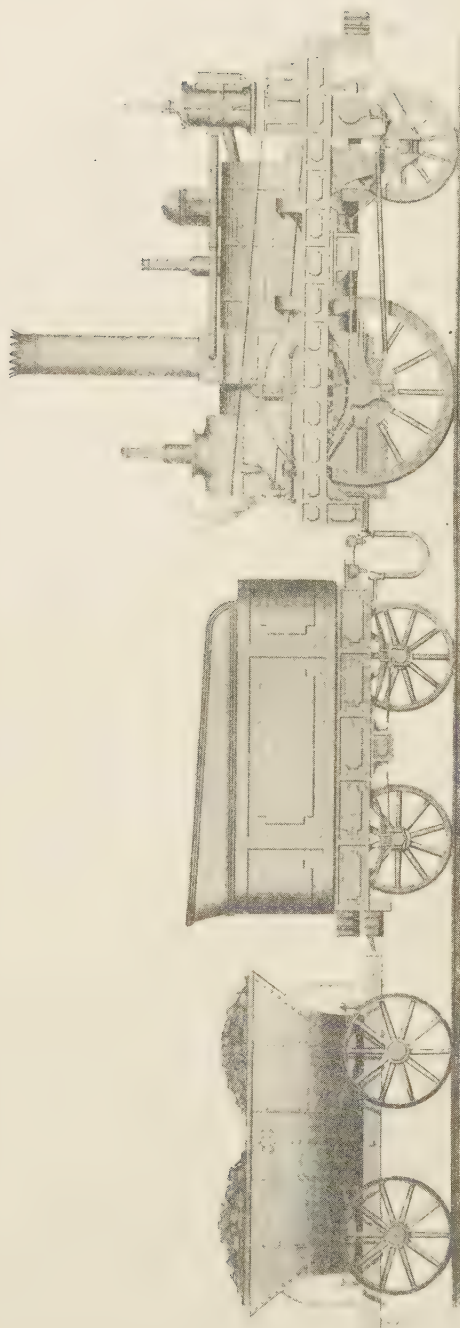
Read a report from Mr. Woods of several experiments with Coal as fuel, in the Patentee and Star Engines. The Coal required to be screened, to remove the slack. After which the Consumption of Haydock Coal in comparison with good Worsley Coke appeared to be greater in proportion of 100 to 80, or about 25 per cent. more Coal than Coke.

November 21st.

Read a Report from Mr. Edwd. Woods on two performances of the 'Liver' with the double Fire Box the fuel used being in the proportion of about $\frac{3}{4}$ coal and $\frac{1}{4}$ coke. The smoke was not altogether destroyed, but it was very much mitigated and possibly some improvement in this respect might be effected. According to these experiments the cost of Fuel would be reduced in about the ratio of from 24/- to 14/- per ton.

⁹ Minutes, 16th January, 1837. The term 'Blue train' is interesting.

MANCHESTER LOCO-MOTIVE ENGINE.



THE 'MANCHESTER.'

THE 'MANCHESTER.'

The twenty-eighth engine, constructed by Galloway, Bowman and Glasgow, was a more remarkable departure. It was originally called 'Manchester,' being the first to be built in that city, and is illustrated opposite, from a print in the author's collection, agreeing exactly with an old drawing in the possession of Messrs. Galloway. The following references occur in the minutes :

19th September, 1831.

The Treasurer reported that Messrs. Bowman and Galloway had called to make an offer to the Directors of their new Engine the 'Manchester' on such terms as might be mutually agreed on. Messrs. Bowman and Galloway had expressed themselves obliged to the Directors for the opportunity of trying their engine by being permitted to take several loads of goods between Liverpool and Manchester. Ordered that Mr. Stephenson inspect the engine and report on its merits.

10th September, 1832.

Read a letter from Galloway, Bowman and Co., of Manchester, stating that they had constructed a new locomotive engine which they were desirous to try on the railway, and if approved to sell to the Company. Ordered that a fair trial should be made under Mr. Dixon's superintendence, and that Mr. Dixon report thereon.

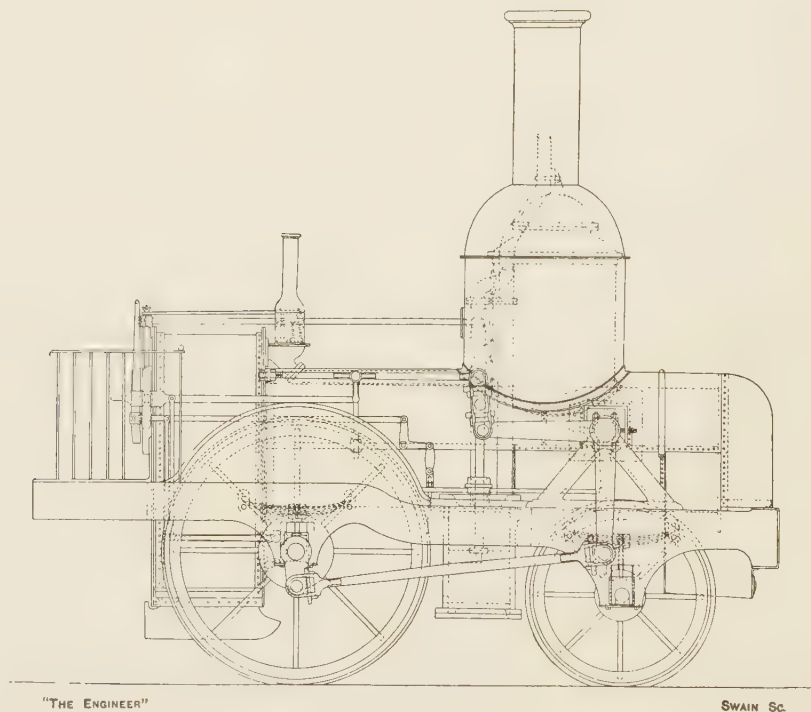


THE 'EXPERIMENT.'

29th October, 1832.

Read the Reports . . . of the 'Caledonian' engine. The Board agreed to give £800 for the engine provided a spare set of strong wheel tires be furnished as part of the engine. The Directors did not wish to purchase the tender.

The engine is also shown in its new form. It was obviously more or less a reconstruction. The figure is taken from a pamphlet called 'The Railway Companion,' 1833, and also occurred in another one of the next year. As only this one engine was shown in these publications, it must be presumed to have been fairly satisfactory at last. In the earlier form it was said to lift itself off the rails! The company evidently did take the tender after all. A minute of 29th May, 1837, records that the engine was sold to the London and Birmingham Railway for £400.



No. 32, 'Experiment,' was another remarkable freak. The illustration above is derived from a drawing signed 'Tho. Turner 1834,' which is still in existence. The valves were of the piston type. Until the discovery of this drawing it was supposed to be like a couple of engines on generally similar lines built by the same firm for the Dublin and Kingstown Railway, which

THE 'PATENTEE.'

have been frequently illustrated¹⁰, but in their case the cylinders were in front of the bell-cranks, being high up over the leading wheels. Minutes relating to this engine :

20th May, 1833.

Read letter from Sharp, Roberts and Co. offering their new Locomotive Engine to the Company for £1,000. Ordered that a trial be made.

7th October, 1833.

Read Mr. Dixon's report on Sharp Roberts and Co.'s engine the 'Experiment,' from which it appeared her consumption of Coke was about 40 per cent. more than some other of the Company's engines, and that there were besides other objections. Resolved that it would not be expedient to purchase the 'Experiment,' and that the Treasurer write to Messrs Sharp Roberts and Co. to that effect, informing them that the Directors would pay a fair price for the work which the Engine had at different times done for the Company.

24th February, 1834.

Read letter from Sharp Roberts and Co., accepting the Directors' offer of £700 for their engine the 'Experiment.'

19th December, 1836.

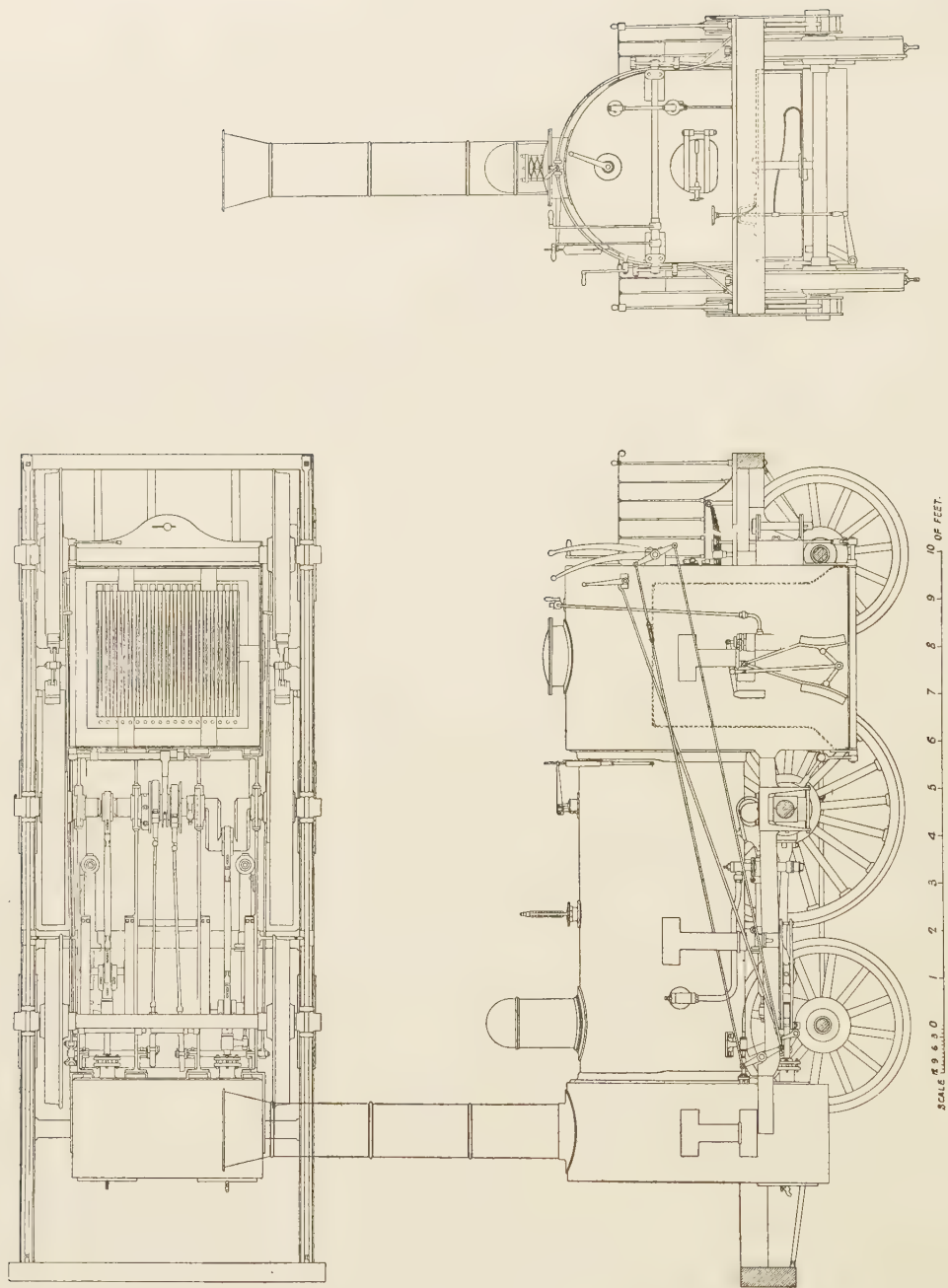
The Treasurer reported that Mr. Locke of the Grand Junction Railway had purchased the 'Experiment' for £500.

A minute of the Grand Junction Directors of 28th February, 1838, is as follows :

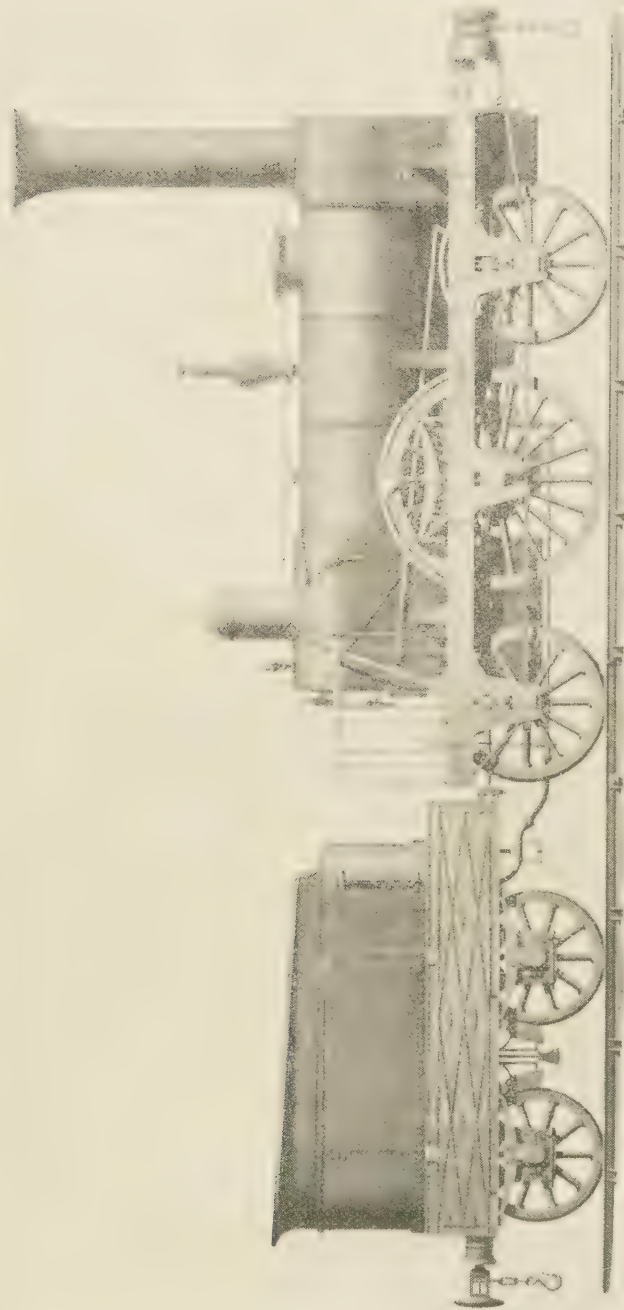
On application from the Birmingham Engine Co. Resolved that Mr. Allcard be authorised to sell to them on the best terms he can procure, the old engine 'Experiment' now at Birmingham.

No. 33, 'Patentee,' the last engine supplied by Stephenson and Co., was a striking landmark in progress. It was produced by lengthening the 'Planet' design and adding a pair of trailing wheels. The feature of the 'patent' was the omission of flanges on the driving wheels. Although the prototype of the engines which ran many of the express trains of this and other countries for half a century, it does not appear from the minutes to have

¹⁰ *Mechanics' Magazine*, vol. XXII, p. 289; Colburn, p. 39; 'A Century,' p. 263.



THE 'PATENTEE.' From the original drawings.



AN ENGINE OF THE 'PATENTEE' TYPE.

THE 'SWIFTSURE.'

come out by any means with a flourish of trumpets; in fact there seems to have been a suspicion of a damp squib about it. This may be partly explained by a note of Seguin's of a journey to England in June, 1834, in which he records that there was at first an attempt to revive the old 'steam spring' idea for the driving axle. Minutes:

28th April, 1834.

Read letter from Robert Stephenson and Co., offering their 6 wheeled engine for £1,050.

19th May, 1834.

Read Mr. Dixon's report of the Six wheeled Engine: Consumption of Gas Coke .78 lb. per ton per mile. Offered R. Stephenson and Co. £1,000 for the engine, provided they fit new and good cylinders, and strengthen frames.

7th July, 1834.

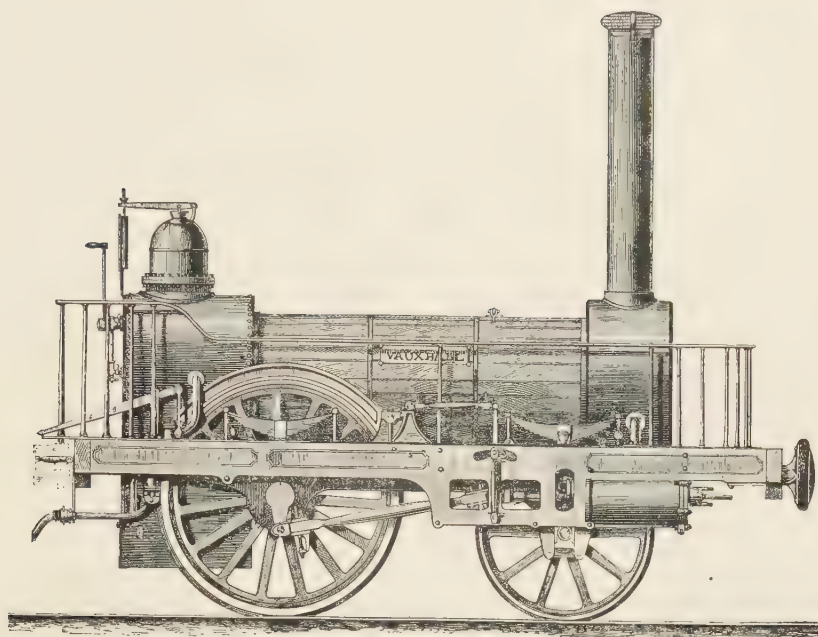
Read letter from Robert Stephenson and Co. accepting above offer and offering to do any additional repairs that might be suggested as necessary.

29th September, 1834.

The Six-wheeled engine purchased from Robert Stephenson and Co. having been repaired at the Vulcan Foundry being again on the line was ordered to be called Patentee.

No. 36, 'Swiftsure,' by Forrester and Co., of Liverpool, was originally a four-wheeled engine, with outside frames and outside horizontal cylinders. Owing to their wide spacing, this engine and three similar ones supplied to the Dublin and Kingstown Railway, were very unsteady in running, being known familiarly as 'Boxers.' One of the Irish engines is shown opposite; no drawing of the 'Swiftsure,' as at first built, being known. But Seguin left sketches of parts of the engine, which he saw in June, 1834, reproduced here, showing a three-bar straight line motion, and a curious kind of single excentric valve motion. Clark and Colburn both illustrate these engines with trailing wheels, which were no doubt added to try and steady them; and a vertical form of Carmichael's valve gear.

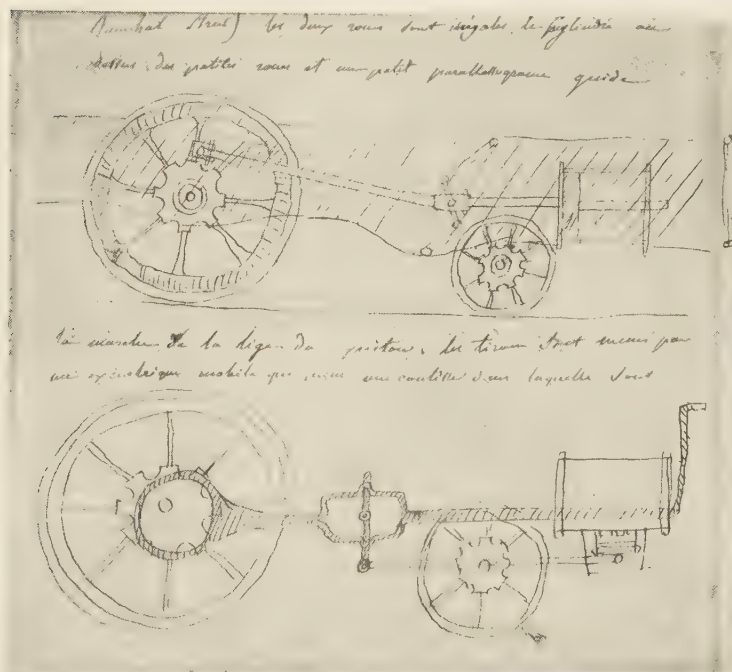
Parallel motions and the like are satisfactory enough for beam engines, in which the angular motion is very small, but would not have sufficient rigidity



"THE ENGINEER"

SWAIN Sc

THE DUBLIN AND KINGSTOWN 'VAUXHALL.'



DETAIL OF THE 'SWIFTSURE,' sketched by Seguin.

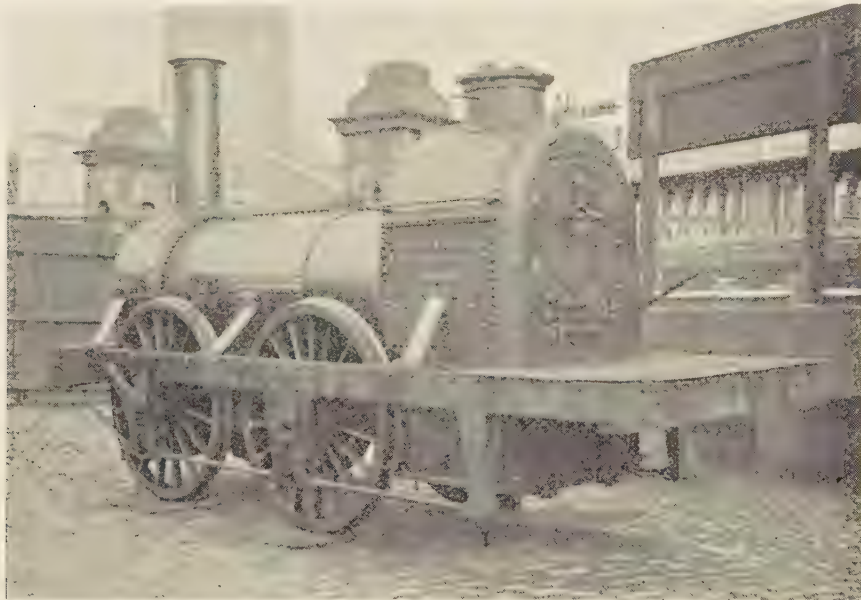
THE 'LION.'

for a direct-acting engine, with the big-end sweeping through a distance equal to the stroke, unless made outrageously massive.

In 1835 someone started after a will o' the wisp in the shape of a short stroke. On the 10th August there was a minute:

With reference to the new Coaching Engines about to be ordered, the Board was of opinion that instead of 4 engines with Pistons of 14 inch stroke, it would be preferable for the purpose of a more decided experiment, to order 2 engines of 12 inch stroke, and the other 2, of the usual stroke of 16 inches; but the matter was referred again to the Sub-Committee for consideration.

The result appeared in engines 41 and 47 to 56.



No. 57, 'Lion,' was sold by the L. and N.W.R. to the Mersey Docks and Harbour Board in May, 1859, and was used to work pumps until quite recently, and is to be preserved¹¹. Above she is shown as retrieved.

A minute of the 21st August, 1837, is evidence of another innovation, a very timid one this time. Two 'coaching engines' were to be ordered with 5 feet 6 inch wheels, as an experiment. These were No. 62 'Leopard' and 64 'Panther,' built by Todd, Kitson and Laird.

¹¹ See *The Locomotive*, January 1929.

JOHN DEWRANCE.

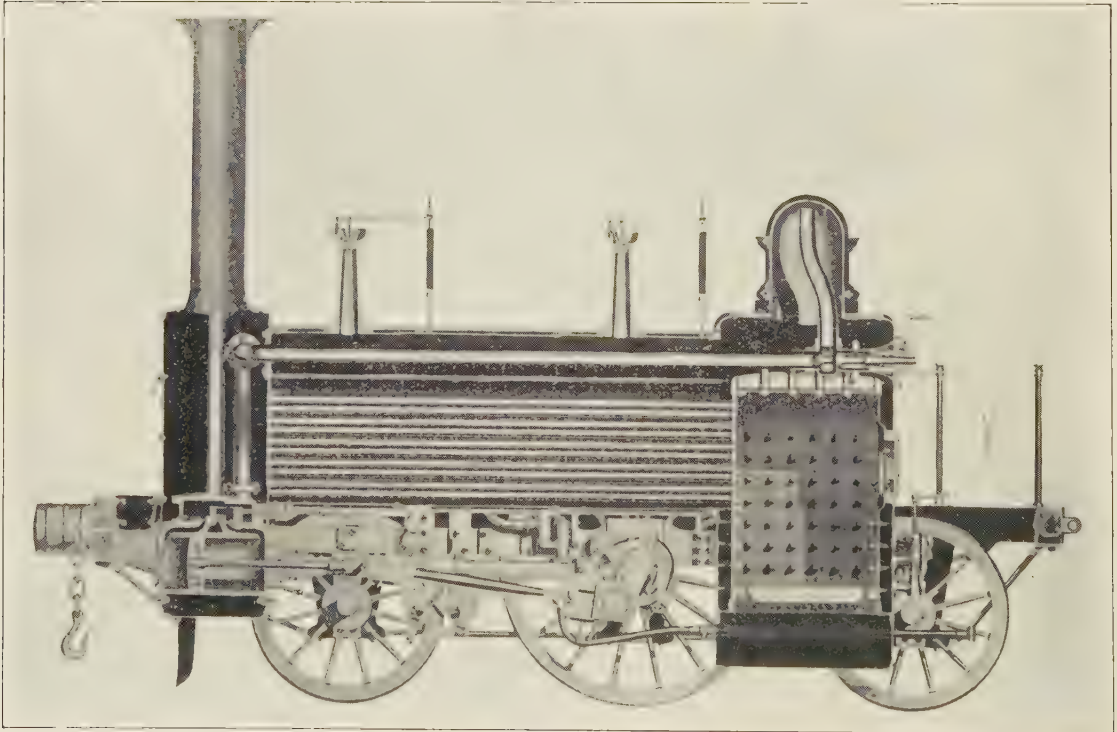
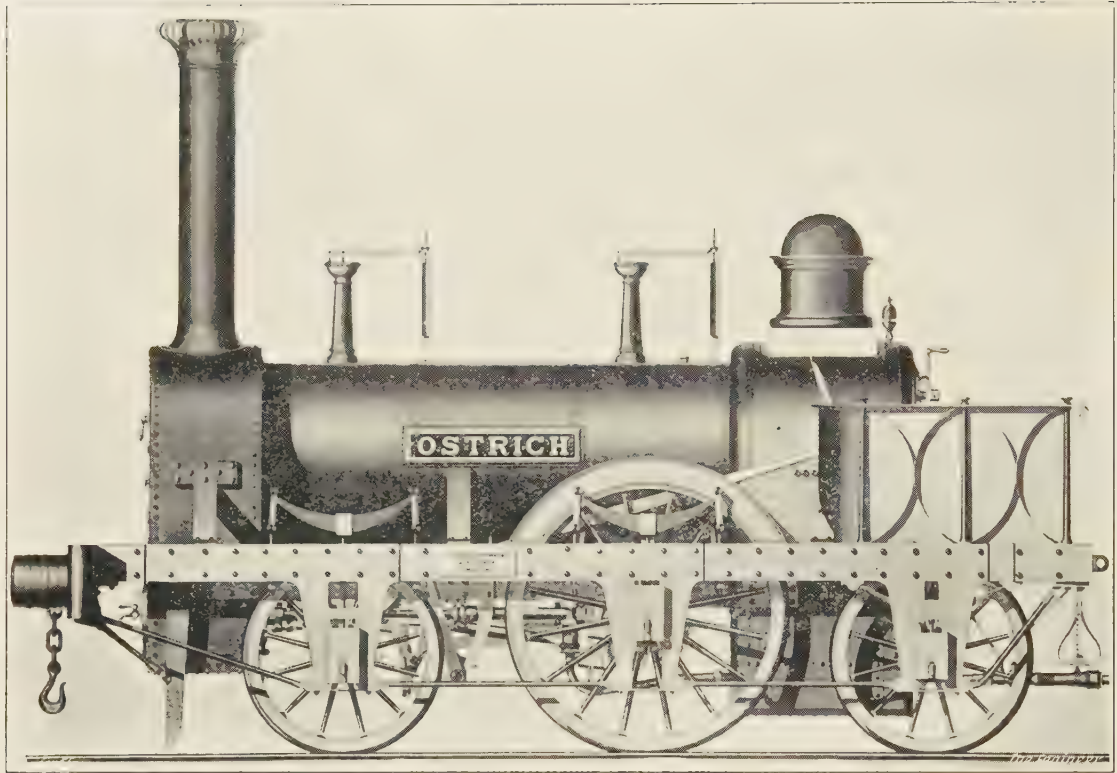
Five feet was the standard size of driving wheel for the L. and M. passenger engines all through. George Stephenson had been strongly opposed to any increase, and his prejudice remained.

Under Dewrance's supervision the locomotive stock was much fortified,



JOHN DEWRANCE (1803-1861).

and standardized on two types; the handsome passenger engines being shown on the next page. They had the usual 5 feet driving wheels; the weight being $15\frac{1}{2}$ tons. The other class was 2-4-0 and is believed to be represented by the succeeding figure, which is from the 'Chronicles of Boulton's Siding.' Five of these engines were purchased by Boulton from the L. and N.W.R. during

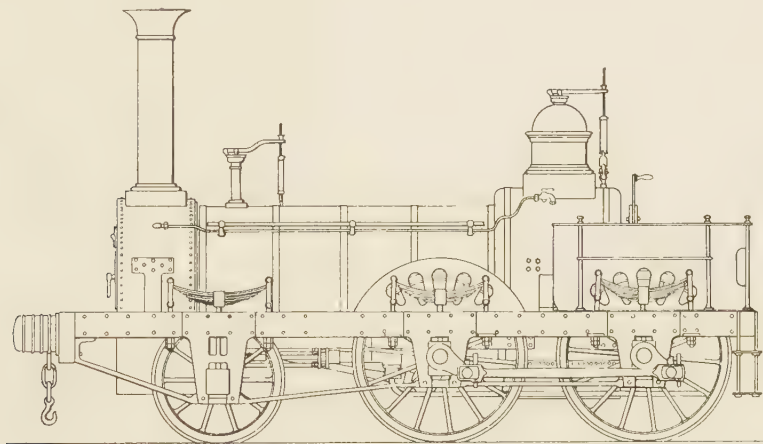


THE LAST ENGINES.

the decade 1860-1870, and were said to have come originally from the L. and M.R.¹²

No. 81, 'Atlas,' is put down in the Dewrance list as a rebuild; it is curious that the original number was not retained.

It is unlikely that Nos. 96 to 105 received L. and M. numbers, as they were delivered after it had ceased to exist independently. The classes are not known except in the case of the 'Condor,' which was a single with 5 feet 6 wheels; fitted with a curious double firebox patented by Dewrance. It is illustrated in Clark and Colburn's 'Recent Practice,' page 26; also in Ahrons' 'The British Steam Locomotive,' page 132.



In the middle of 1845 there were said to be 25 passenger and 18 goods engines, all with 5 feet wheels; the former with cylinders 12 by 18, average weight 15½ tons; the latter 13 by 20, 16½ tons. No engines with four wheels, nor with outside cylinders¹³.

In Tredgold's 'Locomotive and Stationary Engines,' 1850 edition, there is a paper (the fifth) by Edward Woods, entitled 'Observations on the consumption of Fuel and the evaporation of water in Locomotive and other Steam Engines'; mostly based on data obtained from engines on the Liverpool and Manchester Railway. From this paper it appears that during a period beginning in October, 1839, careful records were made of coke consumption, a table of each week's performance being posted up for the

¹² 'Chronicles of Boulton's Siding,' ch. V. See also a letter from A. R. Bennett in *The Locomotive* for Oct., 1927, p. 337.

¹³ Gauge Report; vol. II, p. 513.

FUEL CONSUMPTION.

inspection of the men, which led to the saving of 100 tons of coke per week.

The London, Midland and Scottish Railway possesses the original book containing these records, running from the week ending 26th October, 1839, to 21st August, 1840, omitting two weeks. This book shows that the traffic was worked by about twelve 'coaching' engines, six 'luggage', three 'banking', and six or so 'jobbing'.

The engines in use during that period were Nos. 27 to 68 plus a 'Planet', 'Mars' and 'Victory', but omitting 28 'Caledonian', 31 'Firefly', 32 'Experiment', and 42 'York'. The 'Planet' may have been the original one; it was used for jobbing down to 21st December, 1839; this also applies to 'Mars' and 'Victory', which were employed on the same service from January to March 1840. The 'Caledonian' and 'Experiment' had been sold. The 'Firefly' reappeared in Whishaw's list. The 'York' was under repair, and came out again in 1841.

The fact that the 'Pluto' was used almost continuously for coaching shows that it must have been practically a new engine. The same applies to 'Ajax'. The 'Patentee' was used intermittently for 'luggage'.

Woods states that the adoption in 1836 of short-stroked engines led to an increase of speed, but also to an extravagant increase of coke consumption. Until 1838 there was no lap on the valves. Exhaust clearance was tried on the 'Lightning', which necessitated the addition of $\frac{1}{4}$ inch lap. Other engines then received increased lap, and the 'Cyclops' was fitted with John Gray's patent expansive valve gear. Early in 1840 Dewrance made the lap 1 inch ('Rapid'), producing a 25 per cent. economy, and 'rendering Gray's gear unnecessary.'

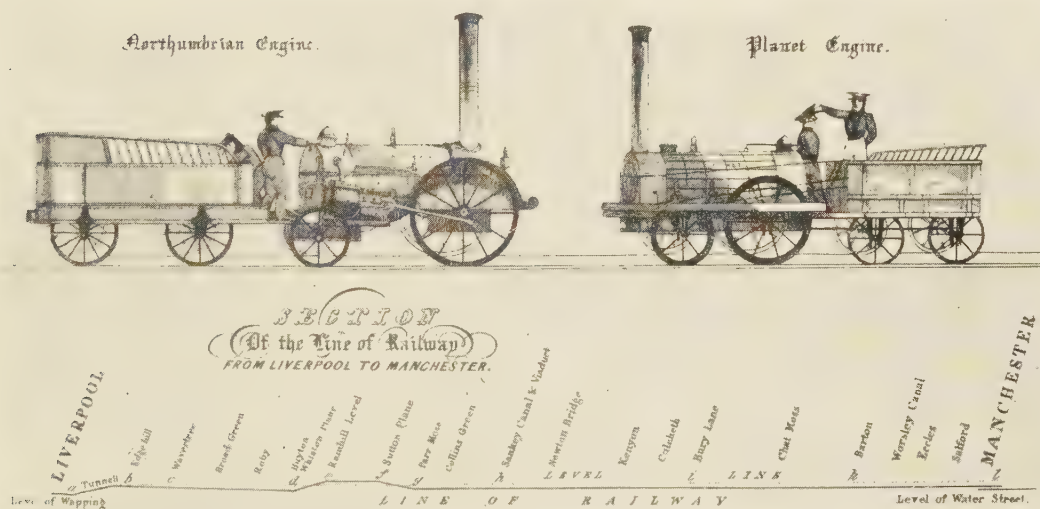
The results of this improvement, which are very striking, are shown below; the figures being pounds of coke per mile (gross).

Summer of 1839. Old valves (i.e., no lap)	49
After new mode of coke deliveries, and encouraging competition	40
Valves with $\frac{3}{8}$ inch lap	36
Do. $\frac{5}{8}$ do.	32
1 inch lap, old passages	28
Same, with increased care in firing	22
1 inch lap, new engines, enlarged passages, etc.	15

RENEWALS.

Woods mentions that during the years 1840, 1841 and 1842 the Company built 24 new engines, and broke up as many old ones. Only 13 new engines, that is to say with fresh names and numbers, show in the list as built during this period; none at all in 1840. It appears from the minutes that on the 17th June, 1839, in reply to 'Mr. Melling's request to be allowed to build a New Engine,' it was resolved that 'when the Swiftsure, the Atlas, the Ajax and Pluto are finished and turned out in complete repair Mr. Melling be authorised to commence building an entire new Engine in his Shed.'

The probabilities therefore are that about eleven engines were built which took the names and numbers of the old ones broken up, thus accounting for some of the very ancient ones—dating from 1834 and 1836; the life of a locomotive was very short in those days—which appeared on the L. and N.W.R.; but they cannot be positively identified. ‘Star,’ ‘Vesuvius’ and ‘Lightning’ are almost certain.



A lithograph by Baird.

Chapter X

THE LOCOMOTIVES: SUPPLEMENTARY.

A NUMBER of engines were tried upon the railway, or offered to it, which were not accepted. Moreover, all sorts and conditions of engines seem to have disported themselves on the line, belonging to contractors, collieries, etc.; traces of the old idea of the railway being a sort of highway still surviving.

In Chapter VI several persons have been mentioned as having made proposals for supplying engines to the company. Others were Anderson and James, who had built road coaches; Pryce, a civil engineer at Neath; J. Sale, or Gale, of London (who suggested that the company should advance him £1,000 for the construction), and William Crawshay. Goldsworthy Gurney entered into rather more prolonged negotiations, but nothing came of them. John Ward of London also wished to build an engine for the railway 'on Mr. Gurney's principle.'

Two engines were built by Braithwaite and Ericsson, both alike, named 'William IV' and 'Queen Adelaide.' One appears in the illustration of the St. Helens Railway 'Intersection Bridge,' shown in Plate XXIV, and on the handkerchief, page 158. A minute of 15th February, 1830, runs:

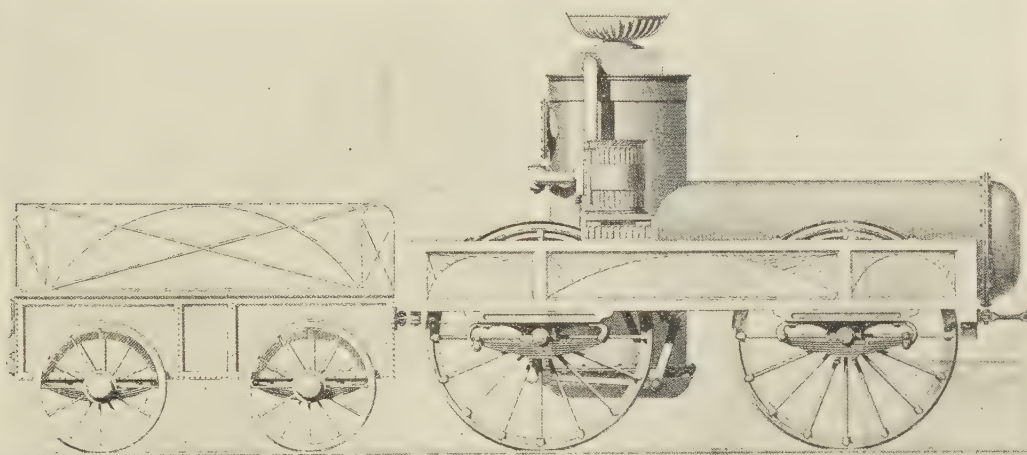
Capt. Ericsson attended, and after discussion the Directors agreed to take two engines from Messrs. Braithwaite and Ericsson on the following terms and conditions—weight not to exceed 5 tons. Gross weight hauled, 40 tons from Liverpool to Manchester in 2 hours, assistance being provided by the Company at the Whiston Inclined Plane, or allowance to be made for loss of speed in that part of the line. Pressure not to exceed 50 lb. per square inch. Consumption of coke not more

THE 'WILLIAM IV.'

than $\frac{1}{2}$ lb. per ton mile. Delivered in Liverpool by 15th June, and to be kept in repair by the builders. £1,000 each.

23rd August, 1830.

Mr. Hodgson reported that Captain Ericsson was gone to Manchester to superintend the fitting up of his Engine, which had arrived at that end of the Railway, and that he would be ready in a few days to perform the stipulated work. . . . Mr. Hodgson further stated that Captain Ericsson in order to show the application of his principle of engine to a high speed, was refitting the Novelty, which he would engage should take 30 passengers from Liverpool to Manchester in *one hour*.



THE 'WILLIAM IV.'

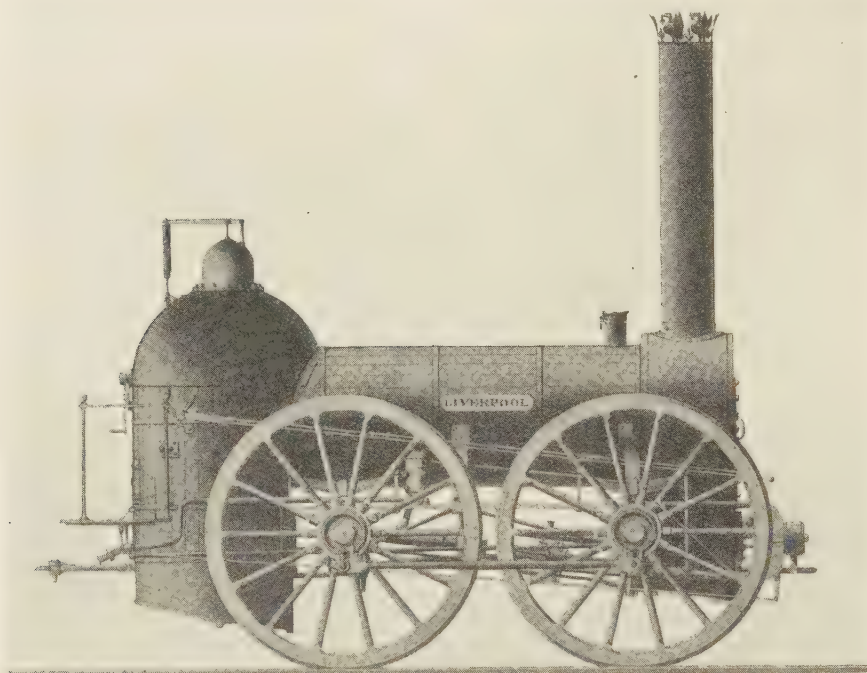
After a good many trials, the engines were rejected, owing to lack of steaming capabilities. They were fitted with exhausting fans, instead of having the air forced into the ashpan like the 'Novelty.' They were apparently used to some extent on the St. Helens Railway.

Edward Bury, of the Clarence Foundry, Liverpool, constructed an engine named 'Dreadnought,' with which he intended to compete at Rainhill, but was unable to finish it in time, and did not get it on to the line until March 4th, 1830. Little is known about it, except that there were six wheels, and two cylinders 10 by 24 inches; and that it was a failure. He then built one named the 'Liverpool,' which at first had a boiler 'with a number of convoluted flues'; the driver and fireman being at opposite ends. It was

THE ' LIVERPOOL.'

reconstructed in the form shown here, which is from a drawing by Bury himself, still in existence, bearing the legend ' The "Liverpool" Loco-Motive. Capable of taking on a level Railway the gross load of 150 tons at the rate of 25 miles per hour. Started July 12th, 1830.'

The cylinders were 12 by 18 inches.



Repeated trials were made, in November, 1830, and in 1831. A minute of 20th June, 1831, is as follows:

Read a letter from Mr. Edw. Bury requesting that his engine the Liverpool might be employed in the conveyance of Goods between Liverpool and Manchester and a fair comparison made between it and one of the most approved constructed by Robert Stephenson and Co. Mr. Stephenson attended and stated that he had no objection to the trial as applied for—but he had to state to the Directors that he considered the 6 feet wheels of Mr. Bury's engine injurious to the road and less safe than 5 feet wheels, which he was of opinion were as large as they ought to be made.

27th June, 1831.

Bury's engine to be worked in turn with the other for 2 months if that period agreeable to Mr. Bury.

It was at last refused (and sold to the Bolton and Kenyon Railway). Stephenson not only objected to the large wheels, but also to the lack of outside bearings, and the circular firebox. A minute of 15th August, 1831, ordered that 'Mr. Bury be informed that in any contract for engines the Directors cannot dispense with the stipulation for outside bearings.'

The 'Liver,' No. 26, was the only engine of Bury's make which was bought by the company.

In 'A Story of Railway Pioneers,' by Major S. Snell, which is really a life of Isaac Dodds, on page 24 the following passage occurs:—

In 1833 a competition for the design of a locomotive engine was opened by the Liverpool and Manchester Railway; the best was that received from the Horsley Iron Company, Isaac Dodds making all drawings and designs in connexion therewith.

On the next page the engine is said to have had horizontal outside cylinders, and to have been named 'Star.' If the statement is correct, it may have been the first to have the cylinders so placed (in front).

The 'competition' referred to was probably merely a request for tenders, which the Board, on at least one occasion, inserted in the newspapers. The true history of this engine appears in the following minutes:

2nd March, 1835.

Read Mr. Dixon's Report on the state of the Way, also his account of an accident to the Engine of the Two o'clock train from Liverpool on Saturday last. Owing to the switch leading out of the St. Helens Junction Line being left wrong placed, the Horsley Engine, the Star which was proceeding with the Train to Manchester was jerked off the rails and ran across to the opposite side of the road when she came into collision with the Caledonian Engine and Tender. Ralph Thompson the Company's Engineman was thrown off and killed on the spot, a working Mechanic belonging to the Horsley Company was also thrown off and had his foot badly crushed by the Engine. The Company's fireman and Barnsley the Horsley Company's Engineer escaped without much injury. The engine having broke loose from the Train, the Coaches kept the way, and after about $\frac{1}{2}$ an hour's delay, were forwarded to Manchester by another engine. The Caledonian Engine was considerably damaged by the collision and her tender was literally broken to pieces. The Horsley Engine was a good deal damaged, her frame being twisted, and one of her cylinders and some of the steam pipes being broken.

THE 'STAR.'

The fact of damage to a cylinder rather confirms the statement that they were outside. A drawing of this engine would be very interesting.

16th March, 1835.

Read Mr. Dixon's Report of the state of the Way also his report on the 'Star' Engine built by the Horsley Iron Company. Resolved that the Horsley Iron Company be informed that this Board on the report of their Engineer decline to purchase the Engine now on the road but that they are prepared to pay the Expenses of repairs occasioned by the accident.

27th May, 1835.

Read a note from Mr. John Pollock, Agent to the Horsley Iron Company, stating that the 'Star' Locomotive was 'completely repaired and in a highly efficient condition, and that he was ready to deliver her up to the Company.'

Mr. Pollock was referred to the Company's previous letter. On August 3rd, further letters were read from Pollock and Dodds, and the matter was handed over to the Sub-committee to settle their claims in a fair manner. On August 17th a note was read stating that the Dublin and Kingstown Railway had offered £700 for the engine. Under the latter railway, on page 69, Whishaw gives a few dimensions of the 'Star,' but no description.

There are a few further minutes of locomotive interest.

30th January, 1832.

The Chairman stated that the framework of the Venus engine had been broken by Mr. Legh's¹ new engine the 'Newcastle' running against her at the Manchester end.

12th October, 1832.

Read a communication from Mr. Allcard being a certificate of approval for the present during Mr. Stephenson's absence of the engines made by Mr. Bury. One for Mr. Hargreaves², and the other, with coupled wheels, for Messrs. Bournes and Robinson³.

¹ A Mr. John Legh gave evidence before the Parliamentary Committee on the L. and M. Bill of 1825, who was a large miller and corn dealer in Cheshire, and sent most of his corn to Manchester. At the east end of Chat Moss, there was 'Legh's occupation bridge.'

² Hargreaves supplied the power to the Bolton Railway under contract. The engine was the 'Clarence.'

³ Owners of a colliery near Rainhill. Evidently the company inspected engines before they were allowed on the line.

OBJECTIONS AND RESTRICTIONS.

29th October, 1832.

Read a letter from Mr. Stephenson stating that his objections to engine wheels of larger dimensions than 5 feet remained unabated. Though in the case of Mr. Bournes' engine if it was restricted to a slow speed the evil would be less. Ordered that Messrs. Bournes and Robinson be informed that their engine with 5 feet 6 wheels must not run at a quicker speed than 12 miles per hour and that the Departure of the Engine must be so regulated as not to interfere with the other traffic on the way. Resolved that it be a byelaw of the Company that in future no Engine shall be allowed to be introduced on the Rail Way with wheels of a larger diameter than 5 feet. A Circular containing this regulation to be sent to all Engine makers who have furnished Engines for the Rail Way.

16th February, 1835.

Read a note from Mather Dixon and Co. requesting the Directors to purchase their Locomotive Engine the 'Everton.' The Board declined . . . as the construction . . . was not altogether satisfactory.

7th December, 1835.

Read a letter from Mr. Hargreaves enquiring, on the subject of Loco Motive engines to be hereafter brought on the Liverpool and Manchester Rail Way, what weight the Directors would allow on one pair of wheels; when it was Resolved, that not more than 6 tons be allowed on one pair of wheels including the average quantity of coke & water in the Fire Box & Boiler, and that the Directors reserve to themselves now and at all times the power to require an additional or third pair of wheels to be placed under any engine working on their line, for the purpose of giving steadiness to the motion, where the same shall be deemed necessary or expedient, by the Company's Engineer.

11th April, 1836.

Read a letter from C. Tayleur & Co. requesting permission to try two New Engines (intended for France) on the Liverpool and Manchester line. The Directors declined allowing these Engines to be tried on the Rail Way unless at the entire risk of the Owners.

2nd July, 1838.

Read Mr. Woods' report to Melly Prevost & Co. on the performance of a new engine called 'the Prince George' with Chanter and Gray's Patent Firebox for the prevention of smoke⁴. This object was very imperfectly accomplished and the consumption of fuel was large compared with that of the Company's engines with Fire Boxes of the ordinary construction. The engine was sold to go abroad.

⁴ These trials are mentioned disparagingly in Clark's 'Railway Machinery,' p. 11; where the engine is called 'Prince George of Denmark.' Melly, Prevost and Co. were exporting agents

‘ FOREIGN ’ ENGINES.

25th November, 1839.

Read Mr. Woods’ statement of the performances of the American Engine ‘Victoria’⁵ on the Bolton Incline planes⁶, which appear to have been very much the same as the performances of the Liverpool and Manchester Engines, taking into account the ratio of Inclination, Weight of the Load, and calculated power of the Engine.

In the records of the performances of locomotives mentioned in the previous chapter, the following engines appear as working on the line. Possibly some were hired to help out. Supply ‘week ending’ before dates.

Chanters’. Used for jobbing 1½ days. 16th Nov., 1839.

Smiths’. Luggage, one day. 14th Dec., 1839.

‘ Bridgewater.’ Luggage, 30 miles. 18th Jan., 1840.

This was the first engine built by Nasmyth, Gaskell and Co. An account of it occurs in a letter to *The Locomotive*, April 1909, p. 84.

‘ Atlas.’ (J. & E.’s or T. & E.’s).	Luggage, 1st Feb., 1840.
‘ Atlas.’ (J. & E.’s or T. & E.’s).	Jobbing, 15th Feb., 1840.
‘ Vesta.’ (J. & E.’s or T. & E.’s).	Coaching, 15th Feb., 1840.

During the week ending 22nd February, 1840, there were two ‘Vestas’ used for coaching, one the last-mentioned, and the other, of course, no. 56. The J, or T. and E.’s disappeared the next week. Probably the initials stand for Jones, Turner and Evans, of Newton-le-Willows.

‘ Nasmyth’s ’ (no doubt the ‘ Bridgewater ’) was used on various services February to May, 1840.

‘ Tayleur’s ’ is entered for coaching, 27th June, 1840; possibly one on trial. Nos. 40, 47, 49, 50 and 51 are also given by name.

‘ Asa.’ Jobbing, 21st Aug., 1840.

This engine is otherwise unknown to fame.

⁵ One of the bogie engines built by Norris and Co., of Philadelphia, for the ‘ Lickey ’ incline of the Birmingham and Gloucester Railway, being No. 6 on that line.

⁶ 1 in 36 (*Observer*, 22nd Feb., 1829).

‘ FOREIGN ’ ENGINES.

In Whishaw’s ‘ Analysis of Railways,’ 1837, among the engines working on the line, one named ‘ Collier ’ is mentioned.

The *Civil Engineers’ and Architects’ Journal* for November 1839, quoting from the *Manchester Courier*, says that the ‘ Soho ’ locomotive, which was the first built by Peel, Williams and Peel, of the Soho Iron Works, Ancoats, Manchester, had been working for a fortnight on the L. and M.R. This engine is evidently not the same as the one of that name on the Bolton Railway, which was built by B. Hick and Son.



TRAVELLING ON THE LIVERPOOL AND MANCHESTER RAILWAY.
Lithograph by Baird.

Chapter XI

THE BUILDERS OF THE ENGINES.

MUCH of the information in the following notes has been drawn from articles contributed by the late E. L. Ahrons to *The Engineer* in 1920 and succeeding years, on famous firms. A very exhaustive list of British locomotive builders was also published in *The Locomotive* for 1927; vol. XXXIII.

Robert Stephenson and Co., Newcastle; since 1902, Darlington.

This, the principal firm of locomotive builders in the early days, dates from 1823, and has constructed well over 4,000 engines. Its history has been set forth in a book which is worthy of the subject, by J. G. H. Warren, called 'A Century of Locomotive Building,' and readers are referred thereto for information.

Fenton, Murray and Jackson, Leeds.

Matthew Murray had built Blenkinsop rack-rail engines as early as 1812. An excellent portrait of him forms the frontispiece to the sixth volume of the Newcomen Society's Transactions. The firm as denominated above was established about 1795. It closed down in 1843 owing to lack of orders, in spite of the fact that they had supplied twenty-three engines to the G.W.R. in 1840-2, which survived for thirty years, more or less. A memorial volume entitled 'Matthew Murray, Pioneer Engineer,' edited by E. Kilburn Scott, was published at Leeds in 1928, which contains a good deal of interesting information.

THE BUILDERS OF THE ENGINES.

Edward Bury and Co., Clarence Foundry, Liverpool.

Probably founded about 1826 (in 1825 Bury was in a timber business). They built a large number of locomotives for home and abroad; over 100 for the London and Birmingham Railway, of which Bury was Locomotive Superintendent. The firm became Bury, Curtis and Kennedy about 1846; but Kennedy had been with Bury from the first. Their most celebrated engine was the 'Liverpool' for the L. and N.W.R.; built 1848, exhibited at the 1851 Exhibition, and broken up in 1858. The firm ceased operations in 1850, after having built about 415 locomotives.

Galloway, Bowman and Glasgow, Manchester.

This firm built the first locomotive in Manchester, but did not follow the pursuit. It is now known as Galloways, Limited.

Sharp, Roberts and Co., Manchester.

Originally founded in 1806, they took up locomotives in 1833, and supplied the 'Experiment' to the L. and M. Railway. Afterwards ten engines to the Grand Junction, and fifteen to the G.W.R., also a number to France and Germany. In 1842 they moved to the Atlas Works; becoming Sharp Brothers in 1843, and Sharp, Stewart and Co., 1852. They supplied the first fifty engines for the G.N.R. in 1847-9, and built the 'Bloomers' on L. and N.W.R. Introduced injectors 1860. Moved to Glasgow 1888 and in 1903 amalgamated with Neilson, Reid and Co., and Dubs and Co., forming the present North British Locomotive Co.

Tayleur and Co., Newton-le-Willows.

Founded by Robert Stephenson and Charles Tayleur in 1832. At first they received a number of 'overflow' orders from R. Stephenson and Co. The firm was called Vulcan Foundry Co. in 1847, and is still in existence, under the name Vulcan Foundry Limited. They supplied a number of engines to the Continent and America, and some for the G.W.R. In *The Engineer* for 3rd January, 1920, it is stated that their first two engines were 'Tayleur' (1) and 'Stephenson' (2); Samson type, 4 feet 8 inch wheels; supplied to Hargreaves of Bolton.

THE BUILDERS OF THE ENGINES.

Forrester and Co., Vauxhall Foundry, Liverpool.

Built for several early railways, but dropped out soon, so far as locomotives are concerned. Their name as Iron Founders appears in the Liverpool directories from 1827 to 1890.

Mather, Dixon and Co., North Foundry, Liverpool.

The same remark applies. They first appear in the directories in 1827 as John P. Mather, Dixon and Co., Iron Founders; in 1837 as Iron Founders, Engineers and Boilermakers, continuing as Mather, Dixon and Grantham until 1843, when they were apparently dissolved; a new firm appearing (at a different address), called John P. Mather, Tomlinson and Co., Iron and Gunpowder Merchants. Among their productions were six engines, two with ten feet wheels, for the G.W.R.

Haigh Foundry, Wigan.

Established 1810, and built 114 engines from 1835 to 1846, when the works closed. They also furnished a couple of the early G.W.R. freaks.

R. and W. Hawthorn, Forth Banks Works, Newcastle-on-Tyne.

Founded 1817 by Robert Hawthorn; became R. and W. H. in 1820. Their first locomotive was the 'Coronation' for the Stockton and Darlington Railway, which was built in 1831. In 1835 they produced the celebrated 'Comet' for the Newcastle and Carlisle Railway. They also built the 'Hurricane' and 'Thunderer' in 1838 for the G.W.R. Between 1848 and 1860 they supplied 105 engines to the G.N.R. In 1884 became R. and W. Hawthorn, Leslie and Co., Limited.

Todd, Kitson and Laird, Leeds.

Founded in 1838, it was the origin of the 'Railway Foundry,' afterwards so well known as E. B. Wilson and Co., of 'Jenny Lind' fame. Their first engines were the 'Lion' and 'Tiger' for the L. and M.R. In 1839 Laird and Kitson withdrew and set up for themselves, while Todd continued under the name of Shepherd and Todd till about 1846, after which the Railway Foundry was carried on by E. B. Wilson, and eventually acquired by Manning, Wardle and Co.

THE BUILDERS OF THE ENGINES.

Rothwell and Co., Union Foundry, Bolton.

Founded about 1830. In the earliest days known as Rothwell, Hick and Rothwell, one of the partners being Benjamin Hick, who left in 1832, and founded the firm now known as Hick, Hargreaves and Co. Their most celebrated engines were the Bristol and Exeter 9-footers, 1853-4. They also built the G.W.R. engines with Crimean names, and supplied a number to France and Germany in the early days. Altogether they constructed about 200 engines between 1830 and 1864, when they closed.

Banks, J.

Said to have built for the Birmingham and Gloucester Railway, as well as the L. and M. Nothing else can be discovered.

B. Hick and Sons, Soho Iron Works, Bolton.

Started by Benjamin Hick in 1832, the name being changed to Hick, Hargreaves and Co., about 1846. They built seven engines of the Bury type for the London and Birmingham Railway in 1837-8, and four for the North Union in 1838-9; also some for America, but seem to have given up locomotives about 1855. This Hargreaves was named William; the one who supplied engines to work the Bolton Railway was John.



*A lithograph by Colyer.
(For 'Odsall,' read 'Ordsall').*

Chapter XII

BRANCH AND CONNECTING RAILWAYS.

I. BOLTON AND LEIGH RAILWAY.

In 1825 an Act was obtained for making a railway from the Manchester, Bolton and Bury Canal, in the parish of Bolton-le-Moors (about eleven miles northwest of Manchester), to the Leeds and Liverpool Canal, in the parish of Leigh. It was opened August 1st, 1828. The course originally proposed for the Liverpool and Manchester Railway would have taken it through Leigh, but the line as constructed passed two miles to the south, and an extension was added by a separate company, afterwards purchased by the B. and L., called the Leigh and Kenyon Railway, in order to connect; which was opened 13th June, 1831. The survey of the latter was made by Robert Stephenson, Rastrick being the Engineer. The total distance from Bolton was only 9 miles 6 furlongs.

There were two 'planes,' worked by stationary engines, called Chequerbent and Daubhill. The line was amalgamated with the Grand Junction Railway at the same time as the Liverpool and Manchester, the arrangement taking effect from July 1st, 1845.

Whishaw, writing in 1840, says 'This line is leased to Mr. Hargreaves, of Bolton, who finds locomotive power, carriages, and wagons, except a few for ballasting which belong to the Company.' (Page 38).

The first locomotive was the 'Lancashire Witch,' supplied about the middle of 1828, which has been described in Chapter V. The following list is taken from Whishaw, and amplified from a list furnished to the Board of Trade dated Oct. 25th, 1841. Originally, there do not appear to have been any numbers. Those allotted by the L. and N.W.R.

BOLTON AND LEIGH RAILWAY.

were 210 to 219, 123 to 125 and 127; the last four of which replaced the L. and M. engines which had received the same numbers, but were transferred to the Permanent Way Department about a year after they had been taken over.

BOLTON AND LEIGH ENGINES.

No.	NAME	DATE	BUILDERS	TYPE	CYLINDERS
—	Sans Pareil ..	Oct. 1829	Hackworth ..	0-4-0	7 x 18
—	Union ..	Dec. 1830	Rothwell ..	2-2-0	9 x 18
—	Salamander ..	May 1831	{ Crook and Dean }	0 4-0	11 x 16
216	Veteran ..	.. ..	.. ..	..	12 x 18
219	Nelson ..	Aug. ..	Stephenson ..	2-2-0	12 x 16
127	Peel ..	Apr. 1832	Bury ..	..	11 x 16
—	Clarence ..	Oct. ..	.. ..	0-4-2	12½ x 18
—	Utilis ..	.. ..	Hargreaves ..	4 c'd.	14 x 18
123	Victory ..	.. ..	.. ..	0-4-2	..
218	Wellington ..	1836	Tayleur (35) ..	..	13 x 18
124	Marquis of Douro	1838	.. (48) ..	..	..
210	Pandora ..	..	.. (54) ..	..	..
125	Soho ..	..	Hick ..	..	..
—	Castle ..	..	Hargreaves ..	..	14 x 18
—	St. David ..	..	Bourne, Bartley	2-2-2	..

The 'Sans Pareil' does not appear in the Board of Trade list; nor does the 'Union,' which was of a curious design, with a vertical boiler, and horizontal cylinders placed high up, driving the rear wheels through rocking levers. It is illustrated on p. 71 of 'Two Essays.' Since that book was written, further evidence has been discovered, which makes it certain that the sketch, in the main, correctly represents the engine. The 'Salamander' is called 'Liverpool' in the B. of T. list. If the date, May 1831, for the two Crook and Dean¹ engines is correct—it comes from Stretton's 'History of the Bolton and Leigh Railway,' of course unaccompanied by any authority—they may perhaps have been among the first hundred railway locomotives. Most of the dimensions are taken from Whishaw, another doubtful guide. The 'Nelson' was a Planet type; it is illustrated in the lower part of p. 300 of 'A Century,' as can be seen if the minute writing on the drawing is examined.

¹ John Crook and William Dean, of The Foundry, Little Bolton.

BOLTON & LEIGH AND ST. HELENS RAILWAYS.

In 1831 Bury's 'Liverpool' was purchased, but had evidently gone out of use by 1840.

The 'Peel' must have had outside frames, like the 'Liver,' as it had been ordered by the L. and M.R., and passed on.² The 'Clarence' was no doubt Bury's standard type, originally with only four wheels, and had been supplied to Hargreaves,³ so with this engine we begin his stock.

Two others belonging to him, which had disappeared by 1840, were no doubt the 'Tayleur' and 'Stephenson'; the first engines built by Tayleur and Co.⁴ It is of course possible that these were used by him elsewhere.

The 'Utilis' was furnished—probably not at first—with eight wheels. Whishaw says (on p. 42) that of the 'Utilis,' 'Victoria' and 'Castle,' two had eight wheels, but in his list of engines only the first-named is so described; four of them being 4 feet 8; two 2 feet 6; and two, 1 foot 8. Doubtless the last pair had been added to smooth the matter over referred to in the following minute of the L. and M. directors, dated 6th February, 1837:

Read the Engineer's report mentioning that the 'Utilis' Bolton Engine weighed upwards of 15 tons and appeared to be seriously injurious to the weak rails. Ordered that the Engineer prevent the Utilis running on the Liverpool and Manchester line.

The 'Victoria' mentioned by Whishaw appears to be a misprint for 'Victory'; also 'Bee' for 'Peel.'

II.—ST. HELEN'S AND RUNCORN GAP RAILWAY,⁵ afterwards St. Helen's Railway (from 1845).

This line ran from St. Helens, which is just north of the L. and M. Railway; crossing, and connecting by spurs with, the latter; to a point opposite Runcorn, where Widnes is now. The Act was obtained in 1830, Vignoles being the engineer. The crossing was effected by a handsome bridge shown in Plate XXIV, which has since been replaced by a steel

² See p. 86.

³ See p. 106.

⁴ See p. 111.

⁵ See p. 186.



PLATE XXIV.

VIEW OF THE INTERSECTION BRIDGE ON THE LINE OF THE ST. HELENS AND RUNCORN GAP RAILWAY, CROSSING THE LIVERPOOL AND MANCHESTER RAILWAY NEAR THE FOOT OF THE SUTTON INCLINED PLANE.

ACKERMANN'S PRINT OF 1832.

To face page 116.

WARRINGTON AND NEWTON RAILWAY.

girder structure. In evidence before the Gauge Commissioners in 1845 Vignoles said the length with branches was about 16 miles; the traffic being chiefly coal from St. Helens to the saltworks in Cheshire, and to steamers in the Mersey.⁶ There was an incline known as the 'Sutton Bank,' about a mile from St. Helens, on which a stationary engine was at first used.

This railway escaped the melting-pot of 1846, and maintained its independence down to 1864, when it was absorbed by the L. and N.W.R., which took over 28 engines.

At first the 'Novelty,' 'William IV' and probably the 'Queen Adelaide' worked there. One of the two latter is seen on the bridge in the plate. In 1845 there were nine engines, all with four wheels. Among the last engines supplied to the line was the first 2-4-2 tank with radial axleboxes; named 'White Raven,' built by James Cross of St. Helens in November, 1863. It is illustrated in Colburn (plate XXIII and page 276), and Ahrons (p. 153). Whishaw does not mention the railway, and it is for all practical purposes ignored in 'Tuck' for 1846.

III. WARRINGTON AND NEWTON RAILWAY.

This was a short line authorized in 1830, Robert Stephenson being the engineer. It ran north from Warrington to a junction with the L. and M. about four miles off, at Newton, or Newton-in-Makerfield, at the point where Earlestown station is now, and became part of the Grand Junction Railway under an Act of 1833.

It possessed three locomotives of the 'Planet' type, built by Stephenson and Co., which were not taken over by the Grand Junction.

- | | |
|---------------|---------------------------------------|
| 1. Warrington | 1st June 1831. |
| 2. Newton | 1st Sept. 1831. |
| 3. Vulcan | 9th Dec. 1831. Afterwards 'Achilles.' |

The dates are recorded in Rastrick's notebook. There is an entry in an old ledger of Stephenson and Co.'s, booking an engine to this Company on April 6th, 1831; price £800.

⁶ Questions 753-8.

NORTH UNION RAILWAY.

IV. WIGAN BRANCH RAILWAY, afterwards NORTH UNION RAILWAY.

This line, the Act for which received the Royal Assent on 29th May, 1830, ran northwards from Parkside on the L. and M.R. to Wigan, a distance of about seven miles. On the 22nd April, 1831, an Act was obtained for a line from Wigan to Preston, and the two were united in 1834 under the name 'North Union'; total length 22½ miles, opened throughout in October, 1838. Another line was also amalgamated with it, called the Bolton and Preston, which was evidently never built in its intended form. Tuck's 'Railway Shareholders' Manual' for 1846 states on page 45, 'An Act was obtained last Sessions for amalgamating this line (North Union) with the Liverpool and Manchester and Grand Junction Railway Companies'; which was no doubt done, as the L. and N.W.R. took over eight engines from it in 1846.

The Wigan branch was opened Sept. 3rd, 1832, the engineer being Vignoles. Whishaw states (on page 388) that the North Union locomotives were all 'on Bury's plan of construction, with four wheels,' except the 'St. George,' which had six wheels. In the list of engines in the Appendix, however, he gives two with six wheels, and what is also curious, no names at all. Whether the 'St. George' was the only one that was christened or not, is unknown. The list is as follows:

NORTH UNION ENGINES, IN 1840.

No.	NAME	DATE	MAKER.	TYPE	CYLINDERS
1	—	1837	Haigh Foundry	2-2-0	11 x 16
2	—	1838	} Jones, Turner { and Evans }	"	12 x 18
3	—	"		"	"
4	—	"	Hick	"	"
5	—	"	"	"	"
6	—	"	"	"	"
7	—	1839	"	"	"
8	—	1838	Haigh Foundry	"	"
9	—	1839	"	"	"
10	—	"	"	"	"
11	—	"	} Jones, Turner { and Evans }	"	"
12	—	"		2-2-2	13 x 18
13	St. George	"	Bourne, Bartley ?	"	12 x 18

NORTH UNION RAILWAY.

The last is referred to in the minutes of the L. and M. directors thus :
6th May, 1839.

Read a letter from Messrs. Bourne, Bartley and Co., Engine Builders, Manchester, offering to the Company their new engine the ' St. George ' for £1400. The letter was accompanied by a copy of Mr. Woods' report of the performances of the Engine which was favourable. The Directors declined purchasing the engine on the ground that they were not at present in want of more Engines.

In *The Locomotive* for May, 1927, on p. 164, this engine is stated to have been really built at the Haigh Foundry, which may have been so.

If Whishaw's dates are correct, all traces of the original stock of engines seem to have disappeared. Possibly they were furnished by Hargreaves.

A Board of Trade return of October 1841 states that this line then had 15 four-wheeled engines, and two with six wheels. The four added subsequently to Whishaw's list were by Bury, and Tayleur; two by each.

The following information is given in the Appendix to the Gauge Report, 1845 :

ENGINES WITH OUTSIDE CYLINDERS.

With 4 wheels; one.

With 6 wheels; the Co. have none, the carrier working the line has two.

ENGINES WITH INSIDE CYLINDERS.

With 4 wheels; 13.

With 6 wheels; 3, N.U. Co. Carriers, 4; Colliers, 7.

According to the above, the company possessed at that time seventeen engines of their own. Four had been supplied by Jones and Potts in 1844. Only eight were taken over by the L. and N.W.R. in 1846, numbered 177-184. The following were probably the names, as they appeared later on N.W. engines.

177	Chimera	181	Pilot
178	Friar	182	Roebuck
179	Nun	183	Theorem
180	Monk	184	Problem

Four others went to the L. & Y.R., being numbered 2, 8, 10 and 12.

GRAND JUNCTION RAILWAY.

V. GRAND JUNCTION RAILWAY.

In 1824, the year before the L. and M. made their first application to Parliament, an attempt was made to obtain an Act for a railway between Birmingham and Birkenhead, to be called the Birmingham and Liverpool Railway. Owing to the frantic opposition of landowners and canal companies, the bill was thrown out; a second one sharing the same fate in 1826, in which year the L. and M. Company was successful. After another failure in 1831, the promoters in 1833 obtained an Act empowering them



to construct a line from Birmingham to Warrington, and to take over the Warrington and Newton, thus connecting with the L. and M. about the middle of its length. It was then named the Grand Junction Railway, since it formed a connecting link between the L. and M. and the projected London and Birmingham Railway. Several of the directors were also on the L. and M. Board. At first George Stephenson and Joseph Locke were appointed joint engineers, but in August, 1835, Locke was made engineer-in-chief, and Stephenson withdrew.⁷

The trains used to divide at Warrington, part going to Liverpool and the rest to Manchester. The length was 82 miles 50 chains; opened throughout 4th July, 1837. In 1840 it bought the Chester and Crewe Railway, which only had a very brief independent existence, if any; taking

⁷ Devey's 'Life of Joseph Locke,' p. 103.

GRAND JUNCTION RAILWAY.

over some engines they had ordered. It was amalgamated with the Liverpool and Manchester in 1845; only a few months before the merger into the L. and N.W.R. Profiting by the experience of the Liverpool and Manchester, they employed six-wheeled engines only, which during the first period were all of one general type, shown opposite.

Frequent breakages of crank-axles occurred, especially when running round the curves connecting with the other line, one turning towards Liverpool, the other to Manchester, the radius being 10 chains.⁸ Consequently, about 1843 a very drastic change was initiated, of reconstructing the engines with outside cylinders. Locke stated in 1845, 'We have nearly one-half of the Grand Junction engines now with outside cylinders, and we are endeavouring to make them all so; every engine that is out of repair, and has to be substantially repaired or renewed, is now renewed on the new system.'⁹

He added, still speaking of the G.J.R.; 'We began that line with a limited number of engines, of a very inferior construction. We had so much difficulty with them that I was obliged to turn my attention to the subject, and it resulted in . . . putting the cylinders outside. I did that with a view of getting rid of a great deal of machinery under the boiler, and also because of the frequent breakages of the crank axle.'¹⁰

In a statement by Alexander Allan, published in *The Engineer* of 25th May, 1885, on p 405, which gives a brief account of his career, he says :

Very short experience of the locomotives on the Grand Junction Railway induced me to attempt a design in which the quick moving parts should be more in view, and easier of access, and by which the expense of crank axles and much connected therewith might be reduced. Crank axles were the formidable items. The drawings of this design were submitted to Buddicom, and to Mr. Locke . . . and permission was obtained . . . to make the experiment on three engines having fair boilers, but requiring new frames, new valve motions and crank axles. These three engines, Aeolus, Sunbeam and Tartarus . . . were reconstructed to my designs.

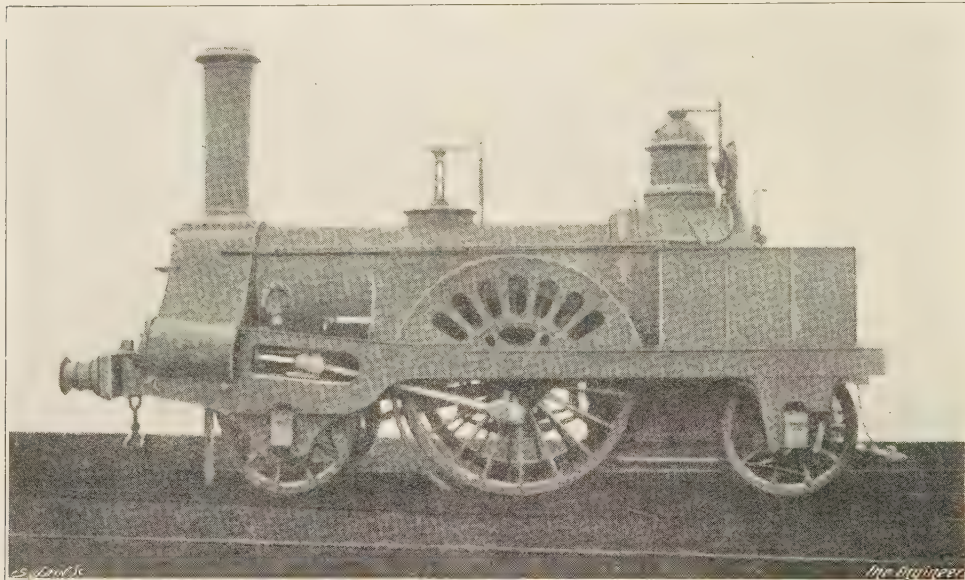
⁸ Captain Huish before the Gauge Commissioners, question 4625.

⁹ Gauge Report, question 387.

¹⁰ Ibid., question 421.

GRAND JUNCTION RAILWAY.

It therefore appears that rumour has been correct in giving the credit for this beautiful design known as the 'Crewe' type, and shown below, to Allan, though Locke, in the statement quoted above, seems inclined to assume it, and a claim has been made for Buddicom. The latter took it to France with him, where it became very popular. The safety valve and dome are strongly reminiscent of Dewrance, as will be seen by looking back to page 98. Similar engines, but with four coupled wheels, were used for goods traffic, some of which survived for an extraordinarily long time.



The very close relationship between the Grand Junction and the Liverpool and Manchester Railways is indicated by the fact that at first the locomotive department of the former was at Edgehill, Liverpool. William Buddicom was appointed Superintendent 1st January, 1840, and in February Allan was made his assistant. In 1843 it was removed to Crewe, under Allan as superintendent, Francis Trevithick being chief mechanical engineer.

The list of engines in 1840 in Whishaw is as follows, down to No. 64; subsequent engines being taken from a list furnished by Mr. W. Laidlaw, and published in *The Engineer* of 14th and 28th June, 1929.

GRAND JUNCTION RAILWAY.

GRAND JUNCTION ENGINES.

No.	NAME	DATE	BUILDERS
1	Saracen	1837	Stephenson (130)
2	Hecla	"	Haigh Foundry
3	Shark	"	Stephenson (131)
4	Hecate	"	Haigh Foundry
5	Falcon	"	"
6	Stentor	"	Rothwell
7	Scorpion	"	Stephenson (132)
8	Wildfire	"	" (133)
9	Alecto	"	Rothwell
10	Dragon	"	"
11	Zamiel	"	"
12	Centaur	"	Sharp, Roberts (F)
13	Prospero	"	Stephenson (134)
14	Witch	"	" (135)
15	Phalaris	"	Rothwell
16	Lynx	"	"
17	Caliban	"	Sharp, Roberts (I)
18	Cerberus	"	" (H)
19	Doctor Dalton ..	"	" (E)
20	Eagle	"	" (G)
21	Wizard	"	" (J)
22	Basilisk	"	" (K)
23	Vizier	"	" (L)
24	Sirocco	"	" (M)
25	Harpy	"	" (N)
26	Aeolus	1838	Tayleur (65)
27	Merlin	"	" (66)
28	Prometheus ..	"	" (67)
29	Alaric	"	Sharp, Roberts
30	Sirius	"	Jones, Turner & Evans
31	Pegasus	"	Tayleur (68)
32	Tamerlane ..	"	" (69)
33	Erebus	"	Sharp, Roberts (6)
34	Phoebus	"	Tayleur (70)
35	Talisman	"	" (71)
36	Thalaba	"	" (72)
37	Hawk	"	Mather, Dixon (43)
38	Camilla	"	Sharp, Roberts (9)
39	Tartarus	"	Tayleur (73)
40	Jason	"	Sharp, Roberts (14)
41	Gorgon	"	Jones, Turner & Evans
42	Sunbeam	"	Tayleur (74)
43	Vampire	"	Hawthorn (253)
44	Harlequin ..	"	Rothwell
45	Sybil	"	Hawthorn (254)

GRAND JUNCTION RAILWAY.

GRAND JUNCTION ENGINES, *continued.*

No-	NAME	DATE	BUILDERS
46	Medea	1838	Sharp, Roberts (23)
47	Vulture	"	Mather, Dixon (44)
48	Oberon	"	Hawthorn (255)
49	Columbine ..	"	Rothwell
50	Hornet		Mather, Dixon (45)
51	Torch		Hawthorn (256)
52	Diomede		Walker
53	Clio		Hawthorn (257)
54	Medusa		Walker
55	Lucifer	1839	Sharp, Roberts (61)
56	Phantom	"	" (65)
57	Sultan	"	" (71)
58	Syren	"	" (73)
59	Vandal	"	" (75)
60	Tantalus	1840	Smith ¹¹
61	Phosphorus ..	"	Mather, Dixon (62)
62	Hyperion ..	"	" (63)
63	Herod	"	Forrester
64	Odin	"	"
65	Charon	1841	Stephenson (260)
66	Colossus	"	Tayleur
67	Briareus	"	"
68	Antaeus	"	"
69	Python	"	Stephenson (261)
70	Sphinx	"	Melling
71	Typhon	"	Stephenson (262)
72	Phlegethon ..	"	" (311)
73	Prince	1845	Crewe
74	Deva	"	"
75	Apollo	Oct. "	"
76	Albion	"	"
77	Mersey	"	"
78	Lonsdale	Jan. 1846	"
79	Belted Will ..	"	"
80	Dalemain ..	"	"
81	Greystoke ..	"	"
82	Wordsworth ..	"	"
83	Windermere ..	Apr. "	"
84	Saddleback ..	"	"
85	Ingestre	"	"
86	Sandon	"	"
87	Eden	"	"
88	Lune	"	"

¹¹ The 'Tantalus' is said in *The Locomotive* for May, 1927 (p. 164) to have been *purchased* from J. Smith of Bradford, but built at the Haigh Foundry.

GRAND JUNCTION RAILWAY.

The first 25 were singles with 5 feet wheels, and cylinders 12½ by 18. The rest down to 64 were similar, but with 5 feet 6 wheels and 13 by 18 cylinders; except Nos. 30 and 41, which were 5 feet coupled, with 13 by 20 cylinders. Nos. 65 to 72 are said to have been also 5 feet coupled, but this is not certain. The Stephenson engines (probably singles) 65, 69, 70 and 71, were built for the Chester and Crewe Railway, and taken over. The rest were all the 'Crewe' type, 6 feet singles, except 78, 81, 82, 83, 87 and 88, which were coupled.

The following were replacements of earlier engines by 'Crewe' singles, 1845-46:

4	Hecate	...	1846	29	Alaric	...	1846
14	Witch	...	1846	33	Erebus	...	1846
16	Lynx	...	1846	44	Harlequin	...	1846
19	Princess	...	1845	49	Columbine	...	1845 (Feb.)
25	Harpy	...	1846	54	Medusa	...	1846 (May)

The 'Columbine' was the first new engine built at Crewe. It was exhibited at Wembley in 1925, and is still in existence.

In the Appendix to the Gauge Report the engines are given for 1845 as 46 with inside cylinders, and 27 outside; all with six wheels.

The following information is taken from the minutes:

In May 1838 Nos. 52 and 54 were ordered from Walker and Co. of Bury at £1,200 each, plus £160 each for the tenders.

In March 1839 No. 19, 'Doctor Dalton' was sold to Mr. Allcard for £600.

On January 8th 1840 the 'Sisyphus' by the Haigh Foundry was declined on the ground of excessive weight.

On January 15th 1840 three engines were ordered from Tayleur and Co. at £1,350, and three from Melling and Co. at £1,400. Two of the latter were not delivered until the beginning of 1842, as a minute of January 12th of that year records an instruction to call them 'Prince' and 'Princess.' On February 9th a letter was read from Melling and Son 'requesting an advance of money on account of the "Prince" engine now delivered' and 'it was resolved that a payment of £1000 on account be made on the certificate of Mr. Trevithick.'

GRAND JUNCTION RAILWAY.

It is probable that they never received the names in question, as they cannot be traced in the lists, and the author is informed by Mr. C. Williams of Crewe, that they took the place of Nos. 1 'Saracen' and 7 'Scorpion.' In that case they must have retained the original names, because later on two of the 'Lady of the Lakes' bore those names and numbers.

On June 10th 1840 Buddicom was authorised to purchase two engines from Forrester and Co. (63 and 64), and to apply outside cylinders and straight axles for the driving wheels to four of the engines 'which have lately been disabled by the breaking of their cranked axles.' These were Nos. 3, 26, 39 and 42. (No. 3 eventually arrived at 'Boulton's siding').

On November 4th 1840 a contract was accepted with Jones, Turner and Evans to supply four engines, and take four unserviceable ones in part payment. The latter cannot be identified.

On February 2nd 1842 Locke reported that Nos. 23, 12, 24 and 31 were quite worn out, and it was arranged for the same builders—now known as Jones and Potts—to take them over, and supply four new ones. Also that two other engines 'would be broken up and rebuilt at the Company's shops at Edgehill.' As a 'Centaur' and 'Pegasus' appeared in later years on the L. and N.W.R. with the same numbers as the originals, it is evident that the names must have been retained on the engines ordered in 1842.

No. 73 was afterwards named 'Prince Albert.'

No. 75 'Apollo' was sold in 1872 to the Malines-Terneuzen Railway, Belgium, and survived at least till 1913.

No. 82 'Wordsworth' was renamed 'Skiddaw.' Most of this class were converted to side tanks, and survived well into the eighties.

No. 87 'Eden' was also turned into a tank, and renamed 'Earlestown.'

No. 88 'Lune' was sold to the Abram Colliery Co., Wigan in 1881.

Chapter XIII

THE EARLY VIEWS OF THE LINE.

THE interest aroused by the railway led to the production of a considerable number of illustrations, the demand for which appears to have lasted for about three years. The following list comprises those publications in which the views form the primary interest, together with prints issued separately. Books containing illustrations subsidiary to the text are dealt with in the next chapter. The most beautiful series of views was published by Ackermann, being hand-coloured aquatints, produced at the time when this process was beginning to be superseded by the very inferior one of lithography.

Early in 1831 a set of seven was issued, 10 inches by 8 in size. They were drawn by T. T. Bury and engraved by H. Pyall. After the edition had been printed off, the titles and publication lines were erased, and a Spanish edition was printed, with the titles in that language, without publication lines. The English titles and publication lines were then replaced, naturally showing small differences.

In July 1831 six more plates were issued in a separate edition, with eight pages of descriptive text. Towards the end of the year, two oblong plates were brought out, measuring 25 by 8 inches, each containing a representation of two trains. The last two were also published in Italy. In 1832 the thirteen small ones were published together, and another added to the series, measuring 17 by 10½ inches. The small plates were retouched from time to time, alterations to the buildings being worked in as they were effected. The later impressions, dated 1833, are very inferior. Two of the Pyall plates were replaced by new ones engraved by S. G. Hughes.

THE ACKERMANN PRINTS.

The title page of the first issue in February, 1831, was as follows :

‘ Six coloured views on the Liverpool and Manchester Railway, with a plate of the coaches, machines, &c. From drawings made on the spot by Mr. T. T. Bury. Price twelve shillings. London : Published by R. Ackermann, 96, Strand, and sold by R. Ackermann, Jun., 191, Regent St.; Printsellers in ordinary to His Majesty. 1831.’

The succeeding English issues had the title page altered by the elimination of the word ‘ six,’ and the addition of ‘ With descriptive particulars, serving as a guide to travellers on the railway.’ The price was also omitted.

The title page to the Spanish edition was as follows:—‘ Seis vistas iluminadas del Camino de Hierro de Liverpool a Manchester con otra lamina de Coches, Maquinas, &c., &c., &c.

Londres : Lo Publica R. Ackermann, 96, Strand. MDCCCXXXI.’

The description and titles to the plates were all in Spanish.

After the English edition of 1833, there was an Italian one of the two oblong plates, with titles in that language.

Publication lines on the prints :

- A. Published Feby. 1, 1831, by R. Ackermann, 96, Strand.
- B. London: Published Feby., 1831, by R. Ackermann, 96, Strand.
- C. London: Published by R. Ackermann, Novr., 1831.
- D. London: Pubd. by R. Ackermann, 96, Strand, 1831.
- E. London: Published by Ackermann and Co., Strand, 1832.
- F. Published Jany., 1833 by Ackermann and Co., 96, Strand, London.
- G. London: Published by Ackermann and Co., Strand, Jany., 1833.
- H. London: Published Feby. 1, 1833, by Ackermann and Co., 96, Strand
- J. London: Published Feby., 1833, by Ackermann and Co., 96, Strand.
- K. London: Published by Ackermann and Co., Strand, 1833.
- L. London: Pubd. by Ackermann and Co., 96, Strand, 1833.
- M. London: Pubd. by Ackermann and Co., Strand, 1833.
- N. London: Published 1834, by Ackermann and Co., 96, Strand.
- O. London: Published 1832 by R. Ackermann, No. 96, Strand, and J. and J. Mawdsley, Liverpool.
- P. London: Published Sept. 30th, 1836, by Ackermann and Co., and Henry Lacey, 64, Bold St., Liverpool.
- Q. Milano: presso gli Editori Pietro e Giuseppi Vallardi’ Conta di’ Sa. Margherita N. 1101.

THE ACKERMANN PRINTS.

STATES OF THE PLATES.

(The numbers in square brackets refer to the present work).

1.—The Tunnel. [Plate V].

State 1.—‘Plate 1.’ Pub. line A, 67 mm. long. Both Ts have a curl at the foot. ‘H. Pyall, sculpt.’ Two figures to left, three to right. A locomotive in the distance.

State 2.—As last, but trucks instead of a locomotive, and hauling ropes added.

State 3.—Spanish.

State 4.—English title, etc., re-engraved. Pub. line A, 75 mm. long. T of ‘The’ ends in a dot.

State 5.—Pub. line H (1833). The three figures to right have been removed. There is a new single figure in the foreground. The train is considerably lengthened, with heavily-laden trucks about the centre of the foreground. In this case the word ‘Plate’ was retained all through.

2.—Entrance of the Railway at Edgehill, Liverpool. [Plate IX].

State 1.—‘Plate 2.’ Pub. line A; curled end to the top of L in title. ‘H. Pyall, sculpt.’ The left chimney is only about one-third built, and is surrounded by scaffolding. No balustrades to stairs.

State 2.—‘2.’ Spanish. (‘Plate’ deleted.)

State 3.—‘2.’ Pub. line B. L in title not curled.

State 4.—‘2.’ As last, but chimney complete, and scaffolding removed.

New Plate.—‘Plate II.’ Pub. line F (1833). ‘S. G. Hughes, sculpt.’ Spiral lines round chimneys. Does not show opening at further end of central tunnel, nor the locomotive emerging therefrom. Balustrades; five lamps.

3.—Excavation of Olive Mount (4 miles from Liverpool). [Plate IV].

(This one is upright, instead of oblong).

State 1.—‘Plate 3.’ Pub. line B. Title 115 mm. ‘H. Pyall, sculpt.’

THE ACKERMANN PRINTS.

State 2.—‘ 3.’ Spanish.

State 3.—‘ 3.’ Pub. line B. Title 131 mm. ‘ Four,’ instead of ‘ 4.’

New Plate.—‘ Plate III.’ Pub. line F. (1833). ‘ S. G. Hughes, sculpt.’ The left side is similar to the previous plate. The rock wall on the right is finished. Some small trees show over the bridge; there is no train going away, and another bridge is seen in the distance.

4.—Viaduct across the Sankey Valley. [Plate VII].

State 1.—‘ Plate 4.’ Pub. line B (65 mm.) ‘ H. Pyall, sculpt.’

State 2.—‘ 4.’ Spanish.

State 3.—‘ 4.’ Pub. line B (69 mm.)

State 4.—‘ 4.’ Pub. line J (1833).

5.—View of the Railway across Chat Moss. [Plate III].

State 1.—‘ Plate 5.’ Curved end to V. Pub. line B (62 mm.) ‘ H. Pyall, sculpt.’

State 2.—‘ 5.’ Spanish. Plate worked up in background.

State 3.—‘ 5.’ V ends in a dot. Pub. line B (73 mm.)

State 4.—‘ 5.’ Pub. line J (1833).

6.—Entrance into Manchester across Water Street. [Plate XI].

State 1.—‘ Plate 6.’ Title reads ‘ Bridge Street ’; an error. Pub. line B (67 mm.) ‘ H. Pyall, sculpt.’

State 2.—As last, but title altered to ‘ Water Street.’

State 3.—‘ 6.’ Spanish.

State 4.—‘ 6.’ Pub. line A (75 mm.)

State 5.—‘ 6.’ Pub. line H (1833). No engraver’s name. A tall chimney added at the top of the elevated water tank. Another chimney in the distance to the rear of train. Three figures in central foreground instead of five. Lamp post on right. No windows in house at extreme right.

THE ACKERMANN PRINTS.

7.—Coaches, etc., employed on the Railway. [Plate XVIII].

State 1.—‘ Plate 7.’ Pub. line B (68 mm.) ‘ H. Pyall, sculpt.’ The ss in ‘ Passengers ’ both short.

State 2.—‘ 7.’ Spanish.

State 3.—‘ 7.’ Pub. line B (75 mm.) Long s in ‘ Passengers.’

State 4.—‘ 7.’ Pub. line J. (1833).

8.—Railway Office, Liverpool. [Plate XVII].

(This is the station at Crown Street).

State 1.—‘ Plate 8.’ Pub. line D. ‘ S. G. Hughes, sculpt.’

State 2.—‘ Plate 8.’ Pub. line M (1833). The triangular space under the roof has been boarded in on the front. The entrance to the tunnel is considerably widened; the joints in the masonry are delineated, and the railway carriages in the distance have been taken out. The pillar at the extreme right has been shortened, and a lean-to shed shows over the top of it. Three lamps have been added, and two notices on the wall to right.

9.—Warehouses, &c., at the end of the Tunnel towards Wapping.
[Plate XII].

State 1.—‘ 9.’ Pub. line D. ‘ S. G. Hughes, sculpt.’

State 2.—‘ 9.’ Pub. line K (1833).

10.—Moorish Arch, looking from the Tunnel. [Plate VIII].

State 1.—‘ Plate 10.’ Pub. line D. ‘ S. G. Hughes, sculpt.’ Wide piers to arch, the characteristic contraction at the springing being strongly marked. No balustrades. Only one lamp, on the left side.

State 2.—‘ Plate 10.’ Pub. line E (1832). The piers have been reduced, the arch being now only slightly contracted, showing more of the bridge in the distance. Iron balustrades have been added to the staircases and the platform on the first floor. Six lamps have been provided. A high wall appears at the top of the right side.

THE ACKERMANN PRINTS.

11.—Near Liverpool, looking towards Manchester. [Plate X].

State 1.—‘ 11.’ Pub. line D. ‘ H. Pyall, sculpt.’

State 2.—‘ 11.’ Pub. line K (1833).

12.—Rainhill Bridge. [Plate VI].

State 1.—‘ 12.’ Pub. line D. ‘ H. Pyall, sculpt.’

State 2.—‘ 12.’ Pub. line K. (1833). There is a great deal of shading spread over the bridge, giving it a weathered appearance. The plates seem to have been usually coloured by artists who were not aware that it was built of red sandstone, and depicted it as if made of grey or yellow stone.

13.—Parkside (The Station where Mr. Huskisson fell). [Plate XVI].

State 1.—‘ Plate 13.’ Pub. line D. ‘ H. Pyall, sculpt.’ There is an open space behind the masonry close to the central water column. The tops of the chimneys of the old cottage (presumably utilised as station buildings) are out of repair.

State 2.—Similar to last, but title altered to ‘ Taking in Water at Parkside.’

State 3.—‘ Plate 13.’ Pub. line L (1833). An engine shed has been built in the open space referred to above, and a tall chimney added to right. The cottage chimneys have been repaired with neat caps.

We now come to the well-known pair of oblong plates, 25 inches by 8, [Plate XX]. Both are entitled ‘ Travelling on the Liverpool and Manchester Railway,’ and depict two trains, one above the other. At the foot they are inscribed ‘ Drawn by I. Shaw, Liverpool ’ and ‘ Aquatd. by S. G. Hughes.’

‘ Plate 1.’ Above the upper train, ‘ A Train of the First Class of Carriages, with the Mail ’; below the lower train, ‘ A Train of the Second Class, for outside Passengers.’

State 1.—Pub. line C. The upper train is drawn by the ‘ Jupiter,’ incorrectly shown with four equal wheels, with a comparatively modern-looking four-wheeled tender; and consists of five similar carriages, usually coloured yellow, followed by a red one carrying the mail. The lower train is hauled by the ‘ North Star,’ with the primitive water barrel tender. There are six

THE ACKERMANN PRINTS.

open carriages, crammed with passengers, all standing up; the first three of which are entered by doors, and the other three by open spaces in the middle.

State 2.—Pub. line G. (1833). The upper train has only four ordinary carriages, the 'Royal Mail' having been moved one forward. At the rear there is now a private open carriage on a truck, containing its owners and their servants. Instead of the three carriages forming the last part of the lower train, there are two, like chars-a-banc, and all of them have canopies.

State 3.—Pub. line Q. Title in Italian. The plate has been retouched practically all over. Names of the artists removed.

'Plate 2.'—Above the upper train, 'A Train of Waggons with Goods, &c., &c.' Below the lower one, 'A Train of Carriages with Cattle.' The upper engine is the 'Liverpool,' with the wheels shown too small. The lower engine is an excellent representation of the 'Fury,' with a splasher on the driving wheel, and a respectable tender, of a type which survived for a number of years.

State 1.—Pub. line C. The last vehicle of the lower train is a double-decked sheep truck.

State 2.—Pub. line G (1833). An open horse-box is substituted for the above-mentioned vehicle.

State 3.—Italian edition, corresponding to the third state of Plate I.

The print added to the 1832 edition, 17 by 10½ inches in size, is entitled 'View of the Intersection Bridge on the line of the St. Helens and Runcorn Gap Railway, crossing the Liverpool and Manchester Railway near the foot of the Sutton inclined plane.'

'Erected by Charles Vignoles, Esqre., C.E., F.R.A.S., M.I.C.E.

'Dedicated by permission to Edward Greenall, Esqre., of Wilderspool, Cheshire.'

Pub. line O. No draughtsman's name. 'S. G. Hughes, Aquatd.' The engine of the train crossing the bridge is either the 'William IV' or 'Queen Adelaide.' This print was issued separately, price 4s. 6d. [Plate XXIV].

THE ACKERMANN PRINTS.

In 1834 an engraving was published bearing four trains, differing slightly from the previous ones, and only 17 inches in length. It is entitled 'Railway Conveyances from Liverpool to Manchester'; pub. line N. The third train has at the end a load of timber, on two trucks.

After the railway was extended to Lime Street in 1836, a plate was issued with three views on it, drawn by S. Kelper, and engraved by John Harris. (Pub. line P.) The two upper ones, which are 8 by $4\frac{3}{4}$ inches, show the interior of Lime Street Station, and the new Edgehill Station, the lower one, $18\frac{1}{2}$ by 6 inches, giving the front elevation of Lime Street Station. [Plate XXI].

The above comprise all the views published by Ackermann which the author has been able to discover. Unfortunately the firm have no record of the engravings they issued.

It will be convenient to deal here with other issues directly derived from the above.

A pair of chromolithographs copied from the 1833 issue of the two long prints was produced by Raphael Tuck and Co. in 1894. They also found imitators abroad. Sir David Salomans had a large coloured lithograph with all four trains on it, issued by Engelmann et fils, Mulhouse. The author has an uncoloured lithograph, also with four trains, $13\frac{1}{2}$ inches by $8\frac{1}{4}$, headed 'Voitures à Vapeur sur le chemin de fer de Liverpool à Manchester.' 'Chez Geslin, rue des Beaux Arts, 17.' 'Lith. de Renou.'

He has also a set of 13 uncoloured aquatints published in Germany in 1832, copied from the small Ackermann plates: 'Das grosste wunderwerk unserer zeit oder die Eisenbahn für Dampfwägen zwischen Liverpool und Manchester in England. Mit 13 Kupferplatten. Nürnberg: Druck and Verlag von Freidrich Campe.' Oblong folio 10 by 8 inches: 5 pp. of description: green wrappers.

A set of lithographs was issued very early, probably in 1830, of small artistic merit, to accompany Booth's Account. Oblong, $10\frac{1}{2}$ by $7\frac{1}{2}$ inches, wrappers. 'Eight views illustrating the Liverpool and Manchester Railway and the engines and carriages employed upon it.' 'Price 7s. 6d. India paper

—5s. plain.' No author or publisher. 'The numbers on each refer to Mr. Henry Booth's Account of the Liverpool and Manchester Railway.'

A beautiful set of etchings was published by I. Shaw of Liverpool in two parts, 'drawn and engraved by I. Shaw Junr.' They were entitled 'A new and complete work of the Liverpool and Manchester Railway; comprising all the most interesting views on the line of Railway, and every other object of public interest connected with it; from drawings taken on the spot expressly for the work, and engraved by I. Shaw, late of Soho Square, London.'

'Liverpool: Published by I. Shaw, Post Office Place; and Grundy & Fox, Exchange Street, Manchester, MDCCCXXXI.'

Part I contains (with a description):

1.—The opening of the Liverpool and Manchester Railway, Sept. 15th, 1830, with the Moorish Arch at Edgehill as it appeared on that day. [Page 59].

2.—The Viaduct over the Sankey Canal. [Page 27].

3.—Newton Church and Village.

(Pub. lines of above, 'Published Jany. 1, 1831, by I. Shaw, Post Office Place, Liverpool, and Grundy & Fox, Manchester.')

4.—The Northumbrian Engine. [Page 80].

(Pub. line similar, but without date).

Part II, also with description:

5.—Chat Moss.

6.—Olive Mount. [Page 23].

7.—Rainhill Bridge. [Page 25].

8.—Planet Engine. [Page 84].

(Pub. lines 'Published March 13th, 1831, by I. Shaw, Post Office Place, Liverpool.')

On the back of the cover is an announcement that Part III would be published 1st May, with four more views. This does not seem to have appeared.

The actual size of the engraved part of these etchings is $8\frac{3}{8}$ by 7 inches.

The ordinary published issue were on paper $10\frac{1}{2}$ by $8\frac{1}{4}$ inches. They are occasionally to be met with in 'proof' form (very fine impressions) on large paper, about 12 by 10. Whether they were ever issued in colours, is rather a doubtful question. The author has only seen a single example, in which case the colouring appeared unquestionably modern. For the warning of collectors it may be pointed out that unscrupulous dealers are in the habit of turning uncoloured engravings into coloured ones, in order to enhance the price; and it is sometimes difficult to say for certain whether the colouring is genuine or not, in cases where it was entirely done by hand.

Before leaving the Shaw series, it is worth giving a short quotation from the description of the 'Northumbrian.'

Its construction is similar in its mechanical principles to the locomotive engine called the Rocket . . . but some parts of its machinery are a little modified. The chief peculiarity in the construction is found in the addition of a branch pipe from the waste steam-pipe to the bottom of the furnace, by opening a cock at the end of which the superfluous steam can be made occasionally to assist the combustion. The modification in material simply consists in the substitution of copper for the boiler and chimney, in the place of iron.

The branch pipe from the exhaust to the ashpan can be seen on the jug in Plate XXVII. Exactly what the last part means, one can only guess, but there are hints to be found elsewhere, of more copper about the 'Northumbrian' than the others. Possibly the boiler was lagged with sheet copper, and the chimney made of brass.

A number of lithographs were produced by Crane of Chester; as follows:

1.—Coloured lithograph of three trains, $14\frac{3}{4}$ by 8 inches; 1st class, 2nd class and goods. Engines 'Northumbrian,' 'Jupiter' and 'Liverpool.'

2.—Coloured lithograph of the 'Phoenix' and a single carriage. $11\frac{3}{4}$ by $6\frac{1}{4}$ inches. Also uncoloured. [Plate XXIII].

3.—A set of small ones, about 7 by $4\frac{1}{2}$, issued in colour, and plain, without any engraver's or publisher's name; as follows:

Moorish Arch.	Bridge over Water St., Manchester.
Olive Mount [Page 24].	'Rocket,' 'Novelty' and 'Northumbrian.'
Sankey Viaduct.	Carriages and permanent way [Page 67].
Newton Bridge [Page 27].	Entrance of the tunnels, Edgehill.
Rainhill Bridge.	

A coloured aquatint by Havell, after a drawing by Calvert, measuring 12 by 8½ inches, was issued by some publisher unknown. It contains a childish representation of a locomotive. The title is 'View of the Manchester and Liverpool Railway. Taken at Newton.' There are reprints about.

The 'Accurate Description' by Walker, published by Cannell, contains at the end (third edition) the following advertisements:

Just Published, dedicated to the Proprietors of the Liverpool and Manchester Rail-road, a Portrait of George Stephenson, Esq., Civil Engineer, from a Drawing by Mr. Moses Haughton. Prints on India Paper 7s. 6d. Plain Paper 5s.

(No copy is known to the author).

This Day are published three Views of the most interesting parts of the Liverpool and Manchester Rail-road. Drawn on the spot by Mr. A. B. Clayton, and Lithographed by the First Artists. Each View is accompanied by a sheet of descriptive Letterpress. Price—Plain Paper 3s. 6d.: India 5s. May be had at all the Booksellers, and at the Publisher's J. F. Cannell, 81, Lord-street, Liverpool.

The author has never seen these with Cannell's imprint, but they are probably the following, in colour, published by Engelmann, Graf and Coindet; all 13 by 9⅞ inches.

- 1.—Moorish Arch. 'On stone by Alfred Clayton.'
- 2.—Olive Mount Cutting. Ditto. [Plate XIII].
- 3.—View of the Liverpool and Manchester Rail Road at the point where it crosses the Duke of Bridgewater's Canal. 'A. B. Clayton, delt. On stone by G. F. Nicholson.' [Plate XIV].

There are two rather crude coloured lithographs by Smoult:

- 1.—Viaduct over the Sankey Canal and Valley. 'Drawn on stone by W. Smoult, Civil Engr., Feb. 3, 1830.' 'Printed from stone by George Smith, Liverpool.' Size 25½ by 16⅞ inches.
- 2.—Sketch of the Bridges and the Excavation at Olive Mount on the line of the Liverpool and Manchester Railroad. 'Drawn on stone by Wm. Smoult, Civil Engineer. Printed by George Smith.' 16 by 10 inches.

SUNDRY PRINTS.

A lithograph of the 'Planet' was published by George Smith of Liverpool. [Page 84].

Lithograph, $28\frac{1}{2}$ by $11\frac{5}{8}$ inches. Bridge crossing the Liverpool and Manchester Railway. From a design by H. S. Merrett, Architect and Surveyor.' 'Lithographed by George Smith.' There is an engine of the Planet type on the upper line, drawing a carriage with 'St. Helens Railway' on it.

Coloured lithograph $14\frac{1}{4}$ by $7\frac{7}{8}$ in. View of the Viaduct over the Sankey Canal on the line of the Liverpool and Manchester Railway. 'W. Benson Lithog. St. Helens.' 'Pubd. by W. Benson, Land Surveyor, St. Helens.'

Lithograph, 10 by $6\frac{3}{8}$ inches. A train drawn by the 'Planet,' with a splasher bearing the name curved in large letters. 'H. Austin, del.' 'Lithd. by Baird, Soth. John Street, Liverpool.' [Page 109].

Another lithograph by Baird is shown on page 101.

Lithograph, $20\frac{1}{2}$ by $7\frac{1}{2}$ inches. View of a Train of Carriages drawn by a Locomotive Steam Engine on a Railway. 'Drawn by Charles Vignoles, Engineer.' 'R. Martin's Lithog. 124 High Holborn.' The engine is the 'Novelty,' the train being rather fanciful. It occurs coloured, and plain; the colouring is sometimes suspicious. [Page 57].

Lithograph, 11 by $6\frac{1}{2}$ in. Railway Station Lime St. Liverpool (a view of the exterior). 'Drawn by R. Barrow, London.' 'W. Crane lithog. Chester.' 'Published by Thos. Kay, 30 Castle St. 1838.'

The following two prints have never been seen by the author in early states. Copies are not very uncommon, but the paper always indicates comparative modernity.

- 1.—Coloured aquatint $12\frac{1}{4}$ by $9\frac{1}{2}$. 'Locomotive Engine the Rocket 1830.' After the drawing by Nasmyth of the 'Northumbrian.' Published in 1895; possibly copied from an earlier print. [Page 81].

A DOUBTFUL PRINT.

2.—Coloured lithograph with four views representing

- (a) Opening of the Stockton and Darlington Railway.
- (b) 'Race of locomotives at Rainhill.'
- (c) A First class train, L. & M.R. 1833.
- (d) A Second class train, do. do.

It is reproduced in Moyaux' book on Railway Medals. The Rainhill view shows four engines; the one obviously meant for the 'Perseverance' being more or less of the Puffing Billy type; a piece of evidence for what it is worth, which is not much, in favour of the 'first coach' theory. But the whole thing is probably quite imaginary; in any case, it cannot have been drawn before 1833. It is quite likely it was produced in 1875, at the time of the Railway Jubilee.



A PIECE OF PRINTED CHINTZ. (*See page 158*).

Chapter XIV

A BIBLIOGRAPHY.

HARDLY a book has been written about railways which does not refer to the Liverpool and Manchester. The following list only includes the more important ones dealing with the subject; omitting accounts which are merely copied from previous works, and do not add anything material in the way of information.

- 1824.—Letter on the projected railroad between Liverpool and Manchester. By Joseph Sandars, Liverpool. Printed by W. Wales and Co., Castle-Street. Tract of 32 pp. There were at least two editions. See p. 10.
- 1824.—A plan and section of an intended Railway or Tramway from Liverpool to Manchester. . . . Surveyed by George Stephenson. Map engraved by J. & A. Walker, London, 20 Nov. 1824.
- 1825.—A short statement of the advantages offered to the public by the proposed railroad between Liverpool and Manchester. Liverpool; Rushton and Melting, Jan. 29, 1825. Broadside with map.
- 1825.—Proceedings of the House of Commons on the Liverpool and Manchester Railway Bill—Session 1825. London: Thomas Davison, Whitefriars. Folio of xii + 771 pp.
- 1825.—Report on Railroads and Locomotive Engines. Addressed to the Chairman of the Committee of the Liverpool and Manchester projected Railroad. By Charles Sylvester, Civil Engineer, Liverpool. Printed by Thomas Kaye.

BIBLIOGRAPHY.

This was a semi-official report, as an introductory letter, dated 15th December 1824, addressed to the Chairman, Charles Lawrence, begins ‘Having been requested by a friend, a Member of your Committee, to inspect, etc.’ It is in favour of locomotives. There were two editions, both 1825.

1829.—Reports to the Directors as to the Comparative Merits of Locomotive and Fixed Engines as a Moving Power. By Jas. Walker and J. U. Rastrick Esqrs., Civil Engineers. Liverpool: Printed by Wales and Baines, Castle Street, 1829. 500 were printed by order of the Board. Walker’s Report (42 pp.) precedes that of Rastrick, which is paged 43 to 80.

Second editions, ‘corrected,’ of both reports were published separately: Walker’s by John and Arthur Arch, Cornhill 1829 (50 pp.); Rastrick’s by R. Wrightson, Athenaeum, New St. (Birmingham), with two other names in addition, 1829.

1829, etc.—*The Mechanics’ Magazine* for this and the two subsequent years contains a quantity of information, not always perfectly accurate.

1830.—Observations on the comparative merits of locomotives and fixed engines as applied to railways; being a reply to the report of Mr. James Walker to the Directors of the Liverpool and Manchester Railway compiled from the reports of Mr. George Stephenson, with an account of the competition of locomotive engines at Rainhill in October, 1829, and of the subsequent experiments. By Robert Stephenson and Joseph Locke, Civil Engineers. Liverpool: Printed by Wales and Baines.

1830.—An account of the Liverpool and Manchester Railway, comprising a history of the Parliamentary proceedings, preparatory to the passing of the Act, a description of the railway, in an excursion from Liverpool to Manchester, and a popular illustration of the mechanical principles applicable to railways. Also an abstract of the expenditure from the commencement of the undertaking, with observations on the same. By Henry Booth, Treasurer to the Company. Liverpool: Printed by Wales and Baines.

The second edition is dated 1831, in which year there was also one

BIBLIOGRAPHY.

issued in Philadelphia by Carey and Lea; preceded by a copy of Walker's Report, and the 'Observations' by Robert Stephenson and Locke.

1830.—An accurate description of the Liverpool and Manchester Railway—the tunnel, the bridges, and other works throughout the line: with a sketch of the objects it presents interesting to the traveller or tourist. By James Scott Walker. Liverpool: Printed and published by J. F. Cannell, 81 Lord Street. 46 pp., folding frontispiece with lith. view of Sankey Viaduct, map, and section of the line. First edition, published before the opening.

Second edition. Enlarged, with an account of the accident. 51 pp. 'Note to the second edition' is dated October 1st 1830. Frontispiece as before, with an additional lithographic view of the bridge over Water Street, Manchester.

Third edition. There were three impressions, all differing. Instead of the previous illustrations, all have Shaw's etchings of Rainhill Bridge and Olive Mount (with the date of publication altered from March 13th to April 18th, 1831).

In print (a) 'Third Edition' is in lower case type. Date 1831.

In (b) 'The Third Edition' is in italic capitals. 1831.

In (c) an account of the branch railways is added, and the title-page is dated and priced '1832, price one shilling.' (The price of (b), which was on the cover only, was 1s. 6d.).

American edition. 'Republished by the standing committee appointed by the inhabitants of Paterson, to forward the application for a Rail-Road from this place to the Hudson River, opposite New York.' Paterson, N.J. D. Burnett, Printer, Van Houten Street, 1830.

1830.—A Guide to the Liverpool and Manchester Railway, with a history of the work and an estimate of its expense with a map of the Railway. Liverpool: Rockliff & Duckworth, 1830. A pamphlet of 16 pp.

1830.—History of the Origin, Rise and Progress of the Liverpool and Manchester Railway. Broadsheet, published by Bethell, Liverpool, price one

BIBLIOGRAPHY.

penny. According to this document, a specimen of which is in the public Library at Liverpool, Vignoles made the first survey for James in 1822. This statement cannot be correct, as the former was in America at the time. There is another piece of information, which may be accurate, and if so is of great interest, namely that a locomotive was, or had been, in use at Orrell Colliery, near Wigan, which drew 6 or 7 waggons of coal.

- 1830.—*Mémoire sur les Chemins à Ornierès.* Par. MM. Léon Coste et Auguste Perdonnet. Paris: Bachelier, 1830.

This book is a reprint, with considerable additions, from the 'Annales des Mines,' 2nd series, Vol. VI (1829). It contains the best description and drawings of the 'Lancashire Witch' that exist. There is also a discussion of the L. and M. Railway, and an account of the Rainhill trials, with sketches, copied from the *Mechanics' Magazine*.

- 1830.—Abstract of the Acts of Parliament relating to the formation and establishment of a Railway from Liverpool to Manchester. Manchester: Printed by W. H. Jones, Mercantile Journal Office, 22 Market St., 1830.

- 1830.—Sketch of the Liverpool and Manchester Rail Way. By H. E. (Edgerley). Shrewsbury. A small pamphlet of 29 pp.

- 1831.—Descriptive and historical account of the Liverpool and Manchester Railway. By Joseph Kirwan. Glasgow: Published by McPhun.

A pamphlet of 32 pp. giving a good, and in places very amusing account of the line. The frontispiece consists of a beautiful line-engraving of the 'William IV.' Reprinted in *Glasgow Mechanics' Magazine*, Vol. V (1834).

- 1831.—Ackermann's Views. These have been described in Chapter XIII.

- 1831.—Shaw's Etchings. The same applies.

- 1831.—Description raisonnée et vues pittoresques du chemin de fer de Liverpool à Manchester. Par P. Moreau, mis en ordre par A. Notré, 98 pp. 4to., map and two folding plates with 9 etchings on India paper. Paris, C. Goeury.

BIBLIOGRAPHY.

An interesting description. One of the folding plates shows a 'Planet' locomotive; the other, details of rails, points, etc. The etchings are all copied from the Ackermann prints except two, which are after Shaw, namely the opening and Chat Moss. It was translated into English, and published at Boston, Mass. U.S.A., 1833. Also into German; Weimar, 1832.

- 1831.—A Practical Treatise on Railroads. By Nicholas Wood. Second Edition.

The first edition of this work appeared in 1825. The second (1831 and 1832) was much enlarged, and contained a full account of the Rainhill contest. A third edition came out in 1838. An American edition was published in 1832. It was translated into French, and published in two volumes, one text and one plates, by Carilian-Goeury, Paris, 1834.

- 1832.—History and Description of the Liverpool & Manchester Railway (anon.). Liverpool: published by Thomas Taylor. A small pamphlet of 72 pp.; of no special importance.

- 1832.—Liverpool and Manchester Railway.

Answer of the directors to an article in the *Edinburgh Review* for October, 1832. Liverpool: Wales and Baines.

There is some interesting information to be gathered from this reply to certain criticisms which had been made of the management of the railway. The 'William IV' and 'Queen Adelaide' are described as 'large and beautiful engines.' Goods were not regularly carried until January 1831, owing to the unexpected rush of passenger traffic.

1832. Remarks on the comparative merits of cast metal and malleable iron railways, and an account of the Stockton and Darlington Railway and the Liverpool and Manchester Railway, etc. etc. Newcastle: Printed by C. H. Cook, 1832 (probably 4th edition). The portions of this work relating to the L. and M.R. consist of a beautiful engraving of a 'Planet' type locomotive (reproduced on page 83); a short account of the beginnings of this line and the Rainhill competition, together with the 'Answer' of the Directors just mentioned.

BIBLIOGRAPHY.

- 1832.—A Letter to a Friend, containing observations on the comparative merits of CANALS and RAILWAYS, occasioned by the Reports of the Committee of the Liverpool and Manchester Railway.

This is an essay of 32 pp. in favour of canals, signed 'F. P.', and dated 'London, February 1st, 1832.' It is followed by a copy of the half-yearly report of the L. and M.R. dated September 28th 1831, which shows a profit of £30,000, of which £24,500 is due to passenger traffic, and £5,500 to goods; apparently without allowing for any depreciation, beyond actual repairs effected. The dividend was £4. 10. 0. per cent. for the half year.

A second edition appeared in the same year, with 'additions arising from the evidence on the London and Birmingham Railway'; dated May 10th, 1832. The author's copy consists of both editions bound together, in contemporary calf.

- 1833.—The Railway Companion, describing an excursion along the Liverpool line, accompanied with a succinct and popular history of the rise and progress of rail roads, illustrated by several lithographic views. By a Tourist. London: Published for the Author by Effingham Wilson, Royal Exchange, and James Fraser, 215 Regent Street.

This is a pamphlet of 46 pp. similar in character to the earlier ones by Walker and Kirwan, but in many respects more interesting. The historical sketch, which occupies half of it, is excellent, also the illustrations, which consist of five folding plates containing ten views, lithographed by E. Colyer, London. Three of them are shown on pages 28, 34 and 113. The locomotive selected for exhibition as a specimen is the 'Caledonian,' in its rebuilt form (see page 89).

- 1833.—Voyage de Manchester à Liverpool par le Raill-way et la voiture à vapeur. Extrait d'un voyage en Angleterre pendant l'année 1831 par M. Cuchetet. Louviers: Ch. Achaintre.

A pamphlet of 25 pp.

- 1833.—The Monthly Supplement to the *Penny Magazine*, No. 69; March 31st to April 30th; a description of the line, with four illustrations.

BIBLIOGRAPHY.

- 1834.—Descriptive Catalogue of the Padorama of the Manchester and Liverpool Rail-road; now exhibiting at Baker Street, Portman Square. 8vo. with 12 lithographic views. Printed by E. Colyer.

The 'Padorama' contained 10,000 square feet of canvas, on which the scenery at the principal points of interest was depicted, and was accompanied by 'correct' models of the engines and carriages. The views in the catalogue are nearly identical with those in the 'Railway Companion' of 1833.

- 1834.—Railroad impositions detected: or facts and arguments to prove that the Manchester and Liverpool Railway has not paid one per cent. nett profit. By R. Cort. London: W. Lake. 8vo., 64 pp.

- 1835.—Description des locomotives Stephenson circulant en Angleterre et en France, etc. Avec 6 planches. Bruxelles: J. B. Champon.

This little book contains the remarkable statement that recently on the L. and M. Railway a locomotive of Sharp Roberts' ran a mile in 57 seconds, a league in 2 minutes 22 seconds, and 25 leagues an hour. As this engine must have been the 'Experiment,' which had vertical cylinders, it appears as if someone had been drawing the long bow.

- 1836.—History and Progress of the Steam Engine. By Elijah Galloway; to which is added an extensive appendix by Luke Hebert. London: Printed by Thomas Kelly.

Thirty-eight pages are devoted to the L. and M.R., with drawings of the engines competing at Rainhill—except the 'Perseverance.'

- 1836.—A Practical Treatise on Locomotive Engines & Railways. By the Chev. F. M. G. de Pambour. English edition published by John Weale, London. An American edition was produced the same year by Carey and Hart of Philadelphia.

This work, which had been published the year previous in French, gives the results of an elaborate series of experiments carried out by this engineer on the L. and M.R. It included a description and drawings of an engine of the 'Planet' type.

BIBLIOGRAPHY.

Second, enlarged, editions were published both in French and English in 1840.

- 1836.—Lacey's Railway Companion and Liverpool and Manchester Guide: describing all the scenery on, and contiguous to the Railway. By Arthur Freeling. 12mo., with a folding plate of trains.

- 1838.—Cornish's Stranger's Guide to Liverpool and Manchester, with the Traveller's Companion on the Railroad, and an accurate engraving of the line of road, a section of the line, etc.

This is a small paper-bound book of 108 pp. of which only 20 are devoted to the railway, the rest consisting of guides to the towns. A similar one had been issued in 1837, which included the Grand Junction Railway as well.

- 1838.—The Iron Road Book and Railway Companion from London to Birmingham, Manchester and Liverpool. By Francis Coghlan. London: A. H. Bailey and Co.

This is a little book of the same style as the last, but as the title indicates, more extensive in scope.

- 1839.—A Practical Treatise on Railways (being the article 'Railways' in the 7th edition of the Encyclopaedia Britannica, with additional details). By Lieut. P. Lecount. London: Adam and Charles Black.

An interesting early account. It says that the 'Planet' was in the Mersey, but not landed, when the railway was opened.

- 1840.—The Railways of Great Britain and Ireland. By Francis Whishaw, M.I.C.E. London: Simpkin, Marshall and Co.

An account of the L. and M.R. is given, together with a copy of the working regulations, and a list of locomotives in 1840. There was a second edition in 1842; the list of engines being the same.

- 1851.—A History of the English Railway. By John Francis. London: Longman, Brown, Green and Longmans.

Three chapters are devoted to the L. and M.R.

BIBLIOGRAPHY.

- 1852.—Our Iron Roads: their History, construction and social influences. By F. S. Williams. London: Ingram Cooke and Co. 8vo. xii + 390 pp.

There is a chapter mostly taken up with the L. and M.R., and an Appendix of 46 pp. consisting of an abstract of the proceedings in connexion with the unsuccessful Bill.

There were several editions; a fourth came out in 1883, published by Bemrose & Sons; xvi + 514 pp., but without the Appendix.

- 1855.—Railway Machinery. By D. K. Clarke. Blackie and Son.

The historical section contains details of some of the early locomotives of the L. and M.R.

- 1857.—Life of George Stephenson. By Samuel Smiles. London, John Murray. This biography contains a long account of the difficulties attending the obtaining the Act and making the railway. From a commercial point of view it is one of the most successful biographies that has ever been written. Admirable as it is in some ways, there are many historical inaccuracies; and the hero is given too exclusive a place in the limelight.

There were a great number of editions. The second, of 1862, was entitled 'Lives of George and Robert Stephenson,' being extended to take in the latter. At the end there is a very interesting 'Narrative of George Stephenson's inventions and improvements in connection with the Locomotive Engine and Railways,' by Robert Stephenson, of twenty pages, which was omitted in subsequent editions. The eighth edition was reached in 1864; there was another in 1868, and a smaller, popular one in 1879.

- 1861.—The Two James's and the Two Stephensons. By E. M. S. P(aine). London: Printed by G. Phipps. See Chapter III.

- 1862.—The Life of Joseph Locke. By Joseph Devey. London: E. Bentley. Though Locke was one of the engineers employed on the L. and M.R., there is little to be gathered from this work on the subject; it being mostly devoted to his later achievements, beginning with the Grand Junction Railway.

BIBLIOGRAPHY.

- 1863.—The Life of Robert Stephenson. By J. C. Jeaffreson. London: Longman, Green.

This biography contains a considerable amount of information relating to the L. and M.R. not in 'Smiles,' especially on the subjects of boiler tubes, and the draught. Many interesting letters are given; including one from George to Robert of April, 1828, in which he proposes to turn part of the exhaust into the firebox. An engine was built about this time with a breeches flue, which was a failure.

- 1869.—Memoir of the late Henry Booth, of the Liverpool and Manchester, and afterwards of the London and North Western Railway. By Robert Smiles. London: Printed for private circulation by Wyman and Sons.

This book is interesting, but does not contain any information of special value on the subject of the railway not to be found in other and more accessible works.

- 1871.—Locomotive Engineering. By Z. Colburn, continued by D. K. Clark. London and Glasgow: Wm. Collins, Sons and Co.

The early locomotives are described at the beginning of this work, and the Rainhill trials. The subjects of tubular boilers and the blastpipe are treated at some length.

- 1875.—Autobiography of Sir John Rennie. London: H. and F. N. Spon. Although the Rennies played for a time an important part in the promotion of the L. and M.R., the subject is only dealt with briefly. It was evidently rather a sore one to them.

- 1889.—Life of Charles Blacker Vignoles, F.R.S., etc. By his son, C. J. Vignoles. London: Longman Green and Co.

The ninth and tenth chapters consist of an account of Vignoles' work on the L. and M.R.

- 1890.—The Life of John Ericsson. By William Conant Church. London: Sampson Low and Co.

There is an interesting chapter dealing with the Rainhill competition

BIBLIOGRAPHY.

and the Braithwaite and Ericsson locomotives. The 'Novelty' closely resembled a steam fire engine (horse-drawn), which Ericsson had built in 1828. The firm failed by 1837.

- 1892.—The Locomotive Engine and its Development. By Clement E. Stretton. London: Crosby, Lockwood and Son.

This book, which has passed through a number of editions, contains a good deal on the subject of L. and M. engines, not all of it accurate. It was only put forward as a popular work.

- 1894.—The Evolution of the Steam Locomotive. By G. A. Sekon.

This is an interesting book, comprising some useful information. Like Stretton's, it is intended for popular consumption. A second edition came out the same year.

- 1914.—The History of the London and North Western Railway. By Wilfrid L. Steel. London: 'The Railway and Travel Monthly.'

The first chapter gives an account of the L. and M.R. It includes a few details of interest not given by Smiles, or the other more ordinary authorities.

- 1923.—A Century of Locomotive Building by Robert Stephenson and Co. By J. G. H. Warren. Andrew Reid & Co. Newcastle upon Tyne.

This is a magnificent book; drawn from unique materials, which have been skilfully turned to account.

- 1923.—Timothy Hackworth and the Locomotive. By Robert Young. The Locomotive Publishing Co. Ltd.

This is a useful book from the historical point of view, though naturally, it bears more on the Stockton and Darlington than the Liverpool and Manchester Railway.

- 1923.—The Liverpool and Manchester Railway. By the author of the present work. 4to., 33 pp., wrappers.

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An excerpt from the Transactions of the Newcomen Society, Vol. II, 1921-22. 50 copies only printed. This was a paper which the author had the honour of reading before the Society on November 16th, 1921.

1928.—Two Essays in Early Locomotive History. By the present author. The Locomotive Publishing Co., Ltd.

The first of the 'Essays' is an attempt to trace the history of the first hundred railway locomotives, about twenty of which were on the L. and M.R.

There is, of course, much information, reliable and the reverse, scattered about in the old files of the engineering press, especially in back numbers of *The Engineer*. A valuable series of articles appeared from time to time in that journal entitled 'Links in the History of the Locomotive'; the most important dealing with the L. and M.R. being in the numbers of the following dates: 30 June, 1876; 17 September, 1880; 18 March, 1881; 23 Feb. and 2 March, 1883. A fierce and wordy warfare over the blastpipe was waged from July to October, 1857. During 1884 and 1885 there was much correspondence, some of it very absurd, on the subject of the 'Rocket.'

Chapter XV.

COMMEMORATIVE MEDALS, AND MISCELLANEOUS OBJECTS OF INTEREST.

MEDALS.

- 1.—BRONZE AND PEWTER. 46 mm. diam. (Plate XXV, Nos. 1 and 2).

Obverse: Head of George Stephenson. Inscr. 'Geo. Stephenson, Esq., Engineer.'

Reverse: View of a bridge of four arches, over which a train is passing, drawn by a locomotive of the 'Killingworth' type. Inscr. 'Bridge at Newton. Liverpool and Manchester Railway opened Sept. 15, 1830.'

- 2.—SILVER, BRONZE AND PEWTER. 48 mm. diam.

Obverse: View of the Moorish Arch. (Plate XXV. No. 3). Inscr. 'Entrance to the Liverpool Station and Tunnels. Published by T. Woolfield Bazaar Liverpool.'

Reverse: View of the Sankey Viaduct, with a train on it, drawn by the 'Rocket.' (Closely resembles Plate XXV, No. 4; except for the inscription). Inscr. at the top, in one curved line 'Viaduct over the Sankey Canal and Valley.' Below, in five straight lines, 'To commemorate the opening of the Liverpool and Manchester Railroad Sept. 15, 1830.' Signed 'Halliday S.'

- 3.—PEWTER, 45 mm. diam.

Obverse: Between two palm branches, in fourteen lines, 'The Liverpool and Manchester Railroad. This grand national undertaking had the Royal Assent April 12, 1827, opened September 15 1830 in the presence



1



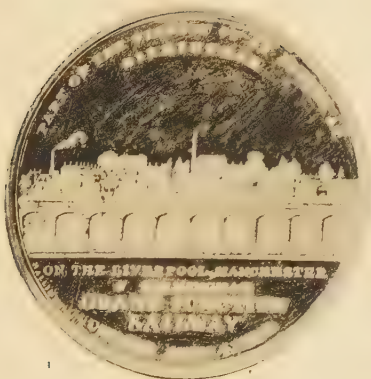
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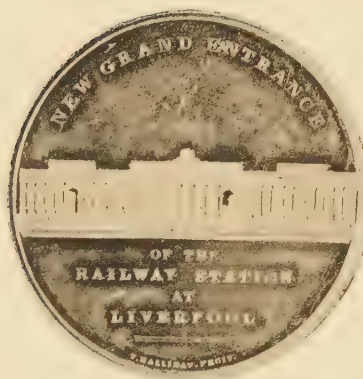
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4



5



6

PLATE XXV.



1



2



3



4



5

MEDALS.

of His Grace the Duke of Wellington and other distinguished Personages.'

At foot 'Ottley.'

Reverse: The Sankey viaduct (Plate XXV, No. 4). Inscr. 'Viaduct over the Sankey Canal & Valley, 14½ miles from Liverpool,' in three curved lines. At foot 'G. Stephenson Esq., Engineer.'

4.—BRONZE, 45 mm. diam.

Obverse: The King's head. Inscr. 'William III ascended the British Throne June 26th 1830, in the 65 year of his age.'

Reverse: As No. 3 above.

5.—PEWTER, 45 mm. diam.

Similar to the last, but with the head of the Duke of Wellington instead of the King.

6.—PEWTER, 49 mm. diam. (Plate XXV, Nos. 5 and 6).

Obverse: A viaduct of ten arches, with a city behind it. Inscr. above, 'Part of the viaduct of 28 arches at Birmingham.' Below, 'On the Liverpool, Manchester & Birmingham Grand Junction Railway,' opened July 4th, 1837.' Signed 'Halliday F.'

Reverse: the outside of Lime Street Station. Inscr. 'New Grand Entrance of the Railway Station at Liverpool. T. Halliday, Fecit.'

7.—PEWTER, 55 mm. diam.

Obverse: A viaduct of 19 arches with two trains on it. (Plate XXVI, No. 1). Inscr. above, 'Viaduct over the Valley of the Weaver.' Below, 'Published to commemorate the opening of the Grand Junction Railway, July 4 1837. By W. B. Promoli, late Thos. Woolfield, Church St. Liverpool.' Signed 'T. Halliday, Fecit.'

Reverse: Similar to No. 6, but inscr. 'Grand Facade of the New Railway Station at Liverpool.'

8.—PEWTER, 47 mm. diam. Said by Stretton to exist in gold. (Plate XXVI, Nos. 2 and 3).

Obverse: View of two converging viaducts, representing the junction of the London and Birmingham and the Grand Junction lines at Birmingham. Inscr. Above, 'Birmingham Liverpool & Manchester.' Below,

MEDALS, ETC.

'Grand Junction Railway. Begun 1835, opened July 4, 1837. Cost £1,500,000. J. Locke Engr.' Signed 'T.W.I.' 'Heeley & Co.'

Reverse: a time table (see illustration).

9.—PEWTER, 38 mm. diam.

Obverse: a time table (Plate XXVI, No. 4).

Reverse: 'Time and Distance from Birmingham' of eight places.

10.—COPPER, 38 mm. diam. Conductor's badge. Author's copy no doubt a proof.

Obverse: Within a wreath composed of roses, shamrocks and thistles, the arms of Birmingham, Liverpool and Manchester. Round the edge, 'Grand Junction Railway Conductor.' (Plate XXVI, No. 5).

Reverse: blank (probably to receive the name of the official).

Several medals were struck to commemorate the Stephenson Centenary in 1881, one of which shows the 'Rocket.' All are very poorly executed.

MISCELLANEOUS OBJECTS.

From 1830 to 1840 there was a considerable vogue for pottery decorated with transfers of railway scenes, manufactured in Staffordshire; consisting of mugs, jugs and, less often, bowls. Plates are known, but are rare. These articles fall into three categories; firstly, and by far the most interesting and valuable, those with what may be called portraits of the earliest engines, among which, curiously, the 'Rocket' is so far unknown; secondly, showing trains drawn by an engine of the 'Planet' class, usually named 'Fury' or 'Jaco'; thirdly and rather later, with what appears to be intended for a Grand Junction train, drawn by a six-wheeled engine resembling Sharp, Roberts and Co.'s design, named 'Express' or 'Nero,' sometimes 'Mail'; none of which names are known to have been used for engines. The landscape background of classes 2 and 3 is always the same, with a church behind the tender. The close resemblance between the views on pieces by different makers is due to the fact that the potters used to send their wares elsewhere to be decorated. In the earliest days of transfer printing they were conveyed on pack horses to Sadler and Green of Liverpool, who claimed to have invented the process; but it is not known if they printed the railway pottery.





PLATE XXVIII.

Three examples of class 1, from the author's collection, are shown on Plate XXVII. The upper one, portraying the 'Novelty' and Moorish Arch, is in violet; $5\frac{1}{8}$ inches high. It has no mark, but the luggage bears the initials G.B. and M.L. which may have some significance. Several examples are known.

The centre one, with the 'Northumbrian' and the Duke of Wellington's train, is believed to be unique. It is $5\frac{3}{8}$ inches high, printed in black, and may possibly be Liverpool pottery. It is marked underneath 'Liverpool and Manchester Railway' in a kind of conventional wreath. Also '2,' and a smudge that might be meant for a W, or a crown.

The lowest one on the left, illustrating the 'William IV,' is also the only example known to the author. It is in lilac-rose; $4\frac{7}{8}$ inches high and 5 inches diameter; the engine is drawing three open trucks full of people. Marked underneath in blue, '5,' and a faint 's.'

The Glaisher collection of pottery, now at the Fitzwilliam Museum, Cambridge, contains one showing the 'Sans Pareil,' reproduced in the last example on Plate XXVII. Black transfer; marked underneath 'Liverpool and Manchester Railway.' It, or a similar one, is illustrated on page 288 of J. F. Blacker's 'A B C of collecting old English pottery,' where it is wrongly described as the 'Rocket.' It is also given in 'The Earthenware Collector,' by G. Woolliscroft Rhead, facing page 212; again called the 'Rocket.'

A fine example of the 'Planet' type of mug is shown on Plate XXVIII. It is only half-pint size, 3 inches high by $2\frac{7}{8}$ diameter. The transfer is sepia, embellished by hand with red, yellow and blue. The drawing, of the 'Fury,' is excellent, and the small transfer round the inside is an unusual attraction. Marked underneath in an architectural frame, 'Hurra for the Railway.' also 'E. J.'

The plate showing the Moorish Arch has the view in green, with the border in pink; $9\frac{1}{4}$ inches diameter. It has an elaborate mark on the back in green of a suspension bridge on which are the words RAIL WAY; above is a shield with E. W. & S. surmounted by a demi-lion rampant, as crest. Made by Enoch Wood and Son, Burslem. The author also has an octagonal plate $9\frac{5}{8}$ inches across, with a Grand Junction train drawn by a six-wheeled engine of about 1840, named 'Nero.' No mark.

POTTERY, ETC.

A tapering jug $6\frac{3}{4}$ inches high, with a dark blue transfer of a train drawn by an engine of the 'Planet' type, is unique for the sake of its associations. It was given by George Stephenson to James Thompson, the purchaser of the 'Rocket,' and acquired by the author from the latter's grandson.

There is also a small mug with a transfer in black of an engine of the 'Northumbrian' type, incorrectly named 'Liverpool.'

Passing over a number of further examples of the 'Planet' type, we come to a bowl and some mugs of the Grand Junction class, which are far from uncommon, and not worth describing in detail. Most are unmarked, but one has 'Railway' in a scroll, and 'H. & B.' The initials probably stand either for Heath and Bagnell, or Hewitt and Buckley, both of Shelton, Staffs. The bowl also has the word 'Railway' in a scroll, but with the initials W. C. and Co. Perhaps Wood and Caldwell of Burslem.

There is also a small plaque of a train with the 'Express' within a bronze and pink lustre frame, $8\frac{1}{2}$ in. by $7\frac{3}{4}$ in. These are often met with.

A collection of over twenty railway mugs, etc., was sold at Sotheby's in 1929 to an American purchaser. Its contents are fairly well covered by the preceding descriptions, but the following marks occurred, which have not been mentioned: B. & B.; B. & L.; G. J. & S.; J. & R. G.

The Hull Municipal Museum has a magnificent glass goblet, 12 inches high, with a view etched on it, copied from the aquatint by Havell described on page 137.

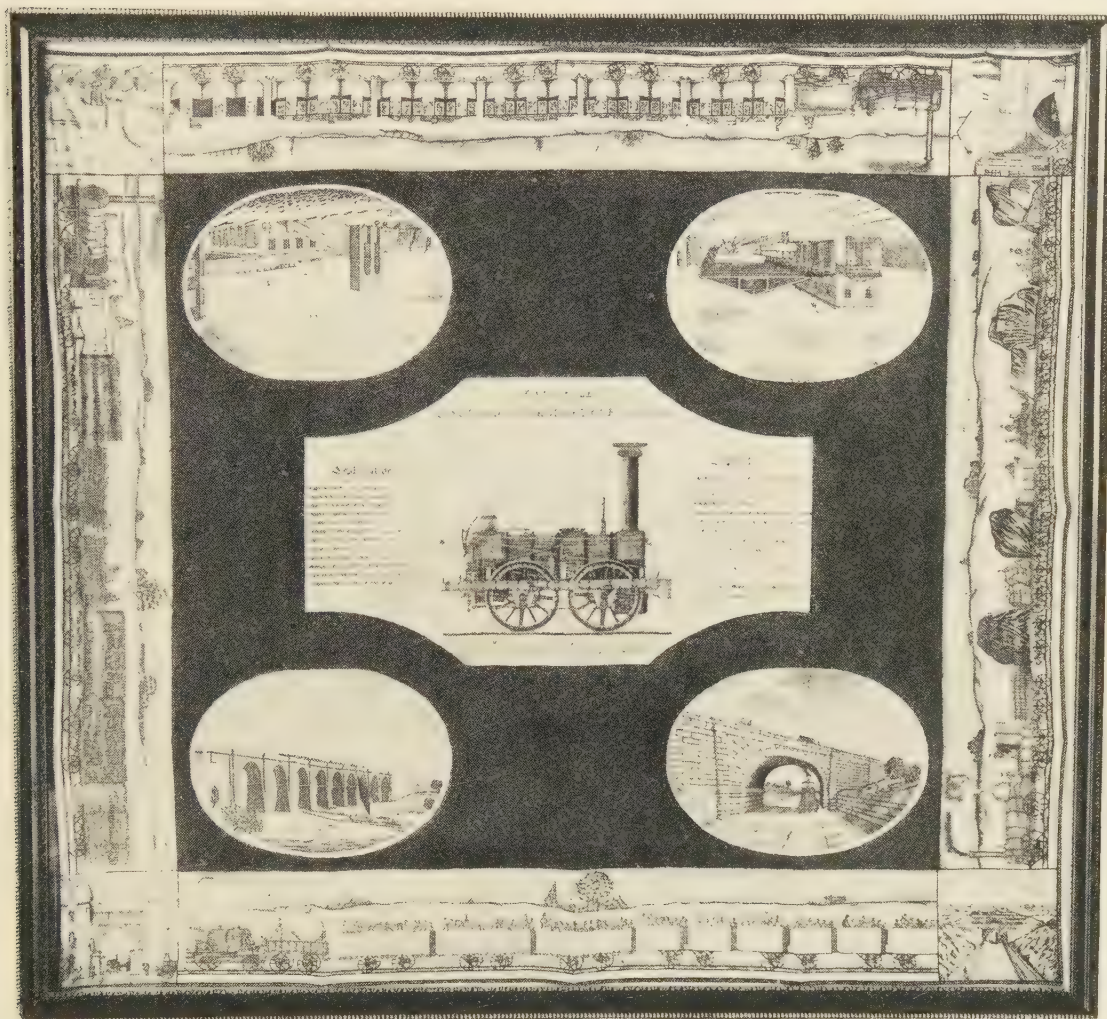
Turning to textile articles, the most remarkable appears to have been a tablecloth; but it is not known whether any specimen survives. In *John Bull* for November 8th, 1835, the following paragraph occurred:

A splendid tablecloth, representing a portion of the Liverpool and Manchester Railway, with carriages, &c., is now in the loom at Tonge, near Middleton. The drawing is almost as accurate as if pencilled: the colours are extremely brilliant and distinct, and the portion of work already executed presents a panoramic view of the scene. The jacquard with which it is being woven, the design, and the workmanship, are all executed by Lancashire artisans.

What a piece for a collector!

HANDKERCHIEFS.

The author possesses two fine printed cotton handkerchiefs, illustrated here; probably produced in Manchester. As will be recognised, the vignettes in the serious one, which measures 32 by 29½ inches, are copied from the Ackermann prints. Three other examples are known, one in the Liverpool



Museum; one at South Kensington, and another, formerly belonging to Sir David Salomans, in Paris. Of the caricature (23 by 19½ inches), no other examples have been seen. It bears the only known representation of the 'Queen Adelaide.' The bridges are meant for the Sankey Viaduct and the

suspension bridge on the Middlesbrough branch of the Stockton and Darlington Railway. Prints on paper exist of the central part, with the same title.

Mr. C. L. Winey of New York has a piece of chintz from a quilt, which has been shown on page 139.

An early jig-saw puzzle was issued by E. Wallis of London, measuring 13 inches by 8 when fitted together; with the train drawn at the opening by 'Northumbrian,' showing the triumphal car, band, etc. Below is another train drawn by the 'William IV,' and four other carriages. There is also a coloured view of the line on the lid of the box.



A curious piece of music called 'The Royal Locomotive Quadrilles,' was published at Manchester, 'respectfully inscribed to Directors of the Manchester and Liverpool Railway,' with an illustration of the 'Rocket' on the cover.

APPENDIX

A TRANSCRIPT OF THE RELEVANT PORTIONS OF RASTRICK'S
RAINHILL NOTEBOOK.



RASTRICK'S BOOK-PLATE.

Appendix

RASTRICK'S RAINHILL NOTEBOOK.

THIS interesting relic, which was acquired by the author in 1929, consists of a small book, measuring $4\frac{1}{2}$ by $6\frac{3}{4}$ inches, bound in black leather. The pages, which are ruled with faint lines running vertically, are water-marked HAGAR & SON 1827. The writing also runs vertically, and is in black ink, unless otherwise stated. The date of the entries is usually expressed in a private code derived from the name John Rastrick, which is sometimes even used for the calculations; as follows:

i	=	1	n	=	4	s	=	7
o	=	2	r	=	5	t	=	8
h	=	3	a	=	6	c	=	9

Various other letters, occasionally Greek ones, are used for o.

Nearly all the entries relate either to the Rainhill trials, or to the Liverpool and Manchester, and neighbouring railways. Those dealing with other matters are now of no interest, and have not been transcribed.

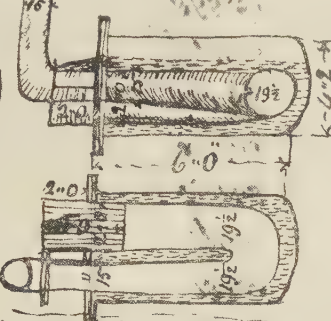
The inside of the cover bears Rastrick's bookplate. The arms are those of his family, which went back for centuries.

On the fly leaf is an undated note 'Rigby Esq. Hawardine North Wales near Chester called to make some enquiry about a Railway he wanted to make in North Wales.'

On the back of the fly leaf are some pencil notes, and a small sketch relating to a Liverpool dock wall.

5 Oct.^r 1829. 11th Sims^y Hackworths Engine given. Yellow
Boiler 4' 2" diam.^r 1/16" In thickness of plate

Fire Tube $\frac{1}{2}$ In thick at top, & $\frac{3}{16}$ thick at Bottom. Flange Every $\frac{1}{16}$ In. thick



"Five Bars 5 ft long

"2 Steam by liners each 7 1/2 d. 10 Irish Sticks

"4 Wheels each. $4\frac{1}{2}$ feet - diam." Incl $3\frac{1}{4}$ inch

by $1\frac{1}{8}$ thick - Flange 1 inch wide & thick.

Feed Pump 2 1/2 In d. 4 Inch Stroke

"Safety Valve 13 3/4 I." Held down by Spring.

"Lock up Valve same D³. D⁴ - D⁵

Call Value. $\frac{3}{4}$ D₂

24 Sept. In area of 178 Calm.

4 $\overline{)120}$ Pound Lead in water

30 Pounds Power of Spring
at end of Leaves.

6 Mar. 1829.

580 ft. $\therefore$ Mt. is 10 Miles per Hour

A Wheel $4\frac{1}{2}$ ft D^m will be 14.13 feet Circumference

$\frac{800}{1483} = 62.278$ strokes per Mⁱⁿ will be 10 Miles per Hour

Single tree 1 1/2 ft double fluke $8\frac{1}{2} \times 4 = 34$ feet velocity of stream $2.27 \times 3 = 6.81$ feet

7 In D. of cylinder ^{29.8 In} 30.40 Area. $\times 30.40 \times 25$ lbs. effective Pressure per Square
Inch = 962 Pounds load upon the Piston -

$186.834 \times 962 = 179,734$ Pounds raised one foot high per Mt. Peck ^{Engine}

179.734 = 5.466 Horse Power of One Cylinder

$$+ 5.446 \times 2 = 10.892 \text{ Horse Power of the Engine at 10 Miles per Hour}$$

supposing the steam kept constantly up, 650 Revs. per Hr.

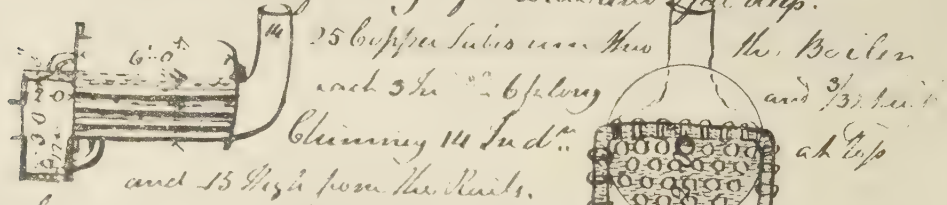
Einbaudie Logels Value & Suppression Ineffective prophenanth Koln 25th Nov 18

Being the Effective Purpose per off. Inks on the Particular case only.

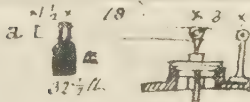
in maintenance at 20 Pounds; in 1st year then the cover of

The Engine would be only 8% Above Power.

Oct. 1829. H. R. Stephensons Rocket Black & Yellow.
 Boiler 3-5 D^o 6 feet long 7/8 In thick full. Ends the same
 Fire Place 2 feet long 3 feet wide and 4 feet deep.



25 Copper tubes run thro the Boiler
 each 3 In 2 6 feet long and 3/32 In thick
 Chimney 14 In d^o at top
 and 15 High from the Rails.
 2 Cylinders each 8 Inches D^o 16 In Stroke
 2. Engine Wheel 5-0 1/2 D^o 3 1/4 wide on axle 7/8 Thick inside 1/2 Thick
 2 Small Wheels 3-0 1/2 D^o Cast Iron case hardened.
 Axis for Engine Wheels 3 1/4 D^o - Axis for small Wheels 3 In D^o -
 Piston Pumps 1 1/2 In d^o diam 16 1/2 In Stroke
 Lock up and Safety Valves each 2 1/2 In d^o diamⁿ.



weight of Valve 1/8 lb. Weight of Lever 1 1/2 lbs.
 The weight of the Lever will operate on pump
 upon the Valve, according to the Ratio of the distance of the Fulcrum
 is to the full length. at the end of the Lever it would require
 2 1/4 lbs. to hold it up & consequently it drops down with a force of
 2 1/4 lbs. $22.5 \times 2.25 = 50.625$ Pounds which the Lever produces at
 the Valve. 3 of these
 Area of Valve 2.55 sq. In. 54 Area.
 Valve 1.125 } 255 total pressure
 Lever 16.075 } 237 Pounds force
 237 + 3 = 240.5 Pounds distance
 32.5 Weight, must be from the
 fulcrum to produce a Pressure of
 237 lbs. on the Valve.
 8 In D^o 50.25 Area
 25 lbs. pressure
 1256.25 Total pressure
 163.625
 205.554 Pounds must be from the
 high pressure of the steam
 205.554 = 6.775 Area of given pressure
 33.000
 10. Miles is 52800 Feet - and 52.800 =
 = 880 feet per minute equal to 60
 tenths of a mile per Hour.
 A Wheel 4-0 1/2 D^o or 56.5 Inches diam^r
 is equal to = 177.5 Feet or Circumference
 equal to 14.8 feet - Circumference
 880 = 59.459 say 59 1/2 ftches per
 minute will be two miles per Hour -
 The lever 60 strokes per minute were more for 10
 16.5 strokes = 1.375 feet stroke = 2.75 strokes at 10 ftches
 2.75 x 59.5 = 163.625 feet Velocity of piston per min
 6.225 x 2 = 12.45 Feet per stroke at 10 ftches per
 stroke the steam kept up to 50 lbs D^o pressure
 given in the safety valve
 Area 20 1/2 In d^o pressure per square In 16 lbs

APPENDIX.

Page 1. -A faint pencil sketch of Brandreth's 'Cyclopede,' with a few notes.

Page 2. Sketches and particulars of Liverpool dock walls.

Page 3. '1829 18 Sept. Arrived at Bolton at half past ten o'clock A.M. '; followed by notes of letters sent and received.

Page 4. Sept. 18th 1829. Compass bearings of sections of the Bolton Railway; and details re canals.

Page 5 Sept. 20th. Details of Bolton canal.

Page 6. '22 Sept. 1829 at Liverpool—wrote out 25 Sept.' This and the five following pages contain details and calculations connected with Winans' carriage with anti-friction bearings. The journals, which were outside the wheels, bore on the upper part of the inside of a kind of cup, eight inches in diameter, which was free to rotate. The figures are of no interest now, especially as he says 'we could not draw any just Conclusions as to the Merits of the Contrivance.'

Pages 12 and 13 contain calculations relative to Attwood's machine.

Page 14 contains some unintelligible formulae, apparently dynamical.

Page 15 dated '19 Nov. 1829, wrote 23 Nov. 1829' is carefully ruled into twelve columns in red ink, and contains very minute details of the Shutt End incline—near Stourbridge, on the line where the 'Agenoria' worked. It was about 366 yards long, with an average inclination of about 1 in 30.

Pages 16 and 17 are devoted to the 'Sans Pareil,' and are reproduced here.

Pages 18 and 19 refer to the 'Rocket,' and are also shown.

APPENDIX.

Page 20. 6th Oct. 1829. Mr. Robt. Stephenson's Engine.

					Ton	cwt.	qr.	lb.
Mr. R. Stephenson's								
Engine said to be					4	„	3	„ 0 „ 0
								3
					12	„	9	„ 0 „ 0
	T.	c.	q.	lb.				
Tender with Fuel & Water	2	„	8	„ 1 „ 0				
Carriage loaded with stones	5	„	1	„ 0 „ 0	12	„	9	„ 0 „ 0
Do. Do.	4	„	19	„ 3 „ 0				as above.
				Engine	4	„	3	„ 0 „ 0
				Gross Weight in motion	16	„	12	„ 0 „ 0

	T	c.	q.	lb.
Engine & Tender	6	„	11	„ 1 „ 0
Carriages and Goods	10	„	0	„ 3 „ 0
Gross	16	„	12	„ 0 „ 0
Engine & Tender	6	„	11	„ 1 „ 0
Carriages	3	„	6	„ 3 „ 0
Goods	6	„	14	„ 0 „ 0
Gross wt.	16	„	12	„ 0 „ 0

Page 21. 6 Oct. 1829 Tuesday. [First day of Competition.]

Distance run by Mr. Stephenson's Engine from the One End to the other was 1½ mile & 308 yards=1.675 miles

8 journies up and down

13.400 Miles

Say 13½ miles Total Distance.

[Exact times are given of starting and stopping each trip; showing the total time to be 1 hour : 7 min : 20 sec.; and the speed 12 m.p.h.]

APPENDIX.

Page 22. 6 Oct. 1829.

		Tons cwt. qrs. lb.
Mr. Braithwait's Engine said to be		2 ,, 15 ,, 0 ,, 0
		3
	Load	8 ,, 5 ,, 0 ,, 0
Deduct Tender made use of to Mr. Stephenson's Engine with Coal & Water	}	2 ,, 8 ,, 1 ,, 0
	Load	5 ,, 16 ,, 3 ,, 0
Empty Tender	1 ,, 14 ,, 3 ,, 0	
Carriage	4 ,, 2 ,, 0 ,, 0	
	5 ,, 16 ,, 3 ,, 0	
To which add Water fuel & say	0 ,, 14 ,, 2 ,, 0	
Load of the Engine	6 ,, 11 ,, 1 ,, 0	
Engine as above	2 ,, 15 ,, 0 ,, 0	
	9 ,, 6 ,, 1 ,, 0	

Page 23. 7 Oct. Liverpool & Manchester Railway. Gradients.

Liverpool Tunnel 1970 yards	$\frac{1}{40}$	Rise 110 feet per Mile.
1000 Do. Level		Level.
5 $\frac{1}{8}$ Miles fall	$\frac{1}{1092}$	4 $\frac{8}{10}$ feet per Mile.
Incline Rainhill 1 $\frac{1}{2}$ Mile rise	$\frac{1}{96}$	55 feet per Mile.
Top of do. 1 $\frac{7}{8}$ Mile Level		Level.
Incline Sutton 1 $\frac{1}{2}$ Mile fall	$\frac{1}{96}$	55 feet per Mile.
2 $\frac{1}{2}$ Miles fall	$\frac{1}{2640}$	2 feet per Mile.
6 $\frac{1}{2}$ Miles fall	$\frac{1}{880}$	6 feet per Mile.
5 $\frac{1}{2}$ Miles rise	$\frac{1}{1200}$	4 $\frac{4}{10}$ feet per Mile.
Manchester 4 $\frac{1}{2}$ Miles Level		Level.

[The gradients have undergone considerable alterations during the years that have elapsed.]

APPENDIX.

Pages 24 and 25.

2 Dec. 1829. Levels taken on the Liverpool & Manchester Railway up Rainhill Inclined Plain—with a Brass chain—42° Temperature.

[Eight points were marked out by stakes, and the gradient of each section carefully determined; they varied between 1 in 93 and 96. Then follow seventeen observations from the foot of the inclined plane towards Manchester].

Page 26. 8 Oct. 1829 (Thursday).

Mr. Robt. Stephenson's Engine	Tons. cwt. qrs. lb.
Weight of engine on the Large Wheels	2 ,, 12 ,, 1 ,, 0
Do Do on the Small Do	1 ,, 12 ,, 3 ,, 0
	4 ,, 5 ,, 0 ,, 0
	3 Times
	12 ,, 15 ,, 0 ,, 0

	Tons. cwt. qrs. lb.	
Tender Empty	1 ,, 12 ,, 0 ,, 22	
Water	1 ,, 6 ,, 3 ,, 4	
Coke	0 ,, 5 ,, 0 ,, 4	
No. 2 Carriage & Goods	3 ,, 4 ,, 0 ,, 2	}
No. 3 Do & Do.	5 ,, 0 ,, 1 ,, 0	
Carriages & Goods	4 ,, 10 ,, 2 ,, 26	}
or usefull weight	9 ,, 10 ,, 3 ,, 26	
		12 ,, 15 ,, 0 ,, 0
		4 ,, 5 ,, 0 ,, 0
		17 ,, 0 ,, 0 ,, 0
		Gross. Wt. in Motion.

Quantity of Coke for getting up steam delivered to engine	}	0 ,, 1 ,, 3 ,, 26
---	---	-------------------

Deduct what remained in fire Place when the Steam was up, which remained at End of Experiment	}	0 ,, 0 ,, 2 ,, 24
		1 ,, 1 ,, 2 = 142 lbs.

APPENDIX.

Page 27.

Water Cask at Commencement of Journey		Second journey	
			Imp. G.
5' „ 2" long inside	} Imp. Gals. 300	Started with	300
3' „ 4" Dr. of End do.			
3' „ 6 $\frac{8}{10}$ Dr. at Bung do.			
Took in 19 gallons of Water at end of sixth Trip at J.U.R. end	} 19	Took in at Mr. Wood's End 8th trip	} 16 — 316
At Mr. Wood's End during the Ninth trip took in		Remained in the Cask at End of this Expt. 6 $\frac{1}{2}$ in. deep of Water	
	16 — 335		30 —
There remained in the Cask at the end of the first Experiment 8 inches deep of Water	} 42 —	Water consumed during the second Expt.	} 286 —
Water consumed during the first Expt.			
	293 —		

Page 28. 8th Oct. 1829. Coke weighed to Robert Stephenson's Engine.

[An account of each sack; showing 1127 lb. consumed in all.]

The Engine stopped for 14 m 34" between the time of finishing the first journey and setting out on the Second, and as the time of performing the whole Journey of 70 miles was 6 h. 23 m. 31" and the Fuel consumed in that time was 1127 pounds

$$\text{Consequently } \frac{1127 \times 14\text{m. } 34''}{6\text{h. } 23\text{m. } 31''} = 42 \text{ lb. for the Coke that}$$

was consumed between the two Journies.

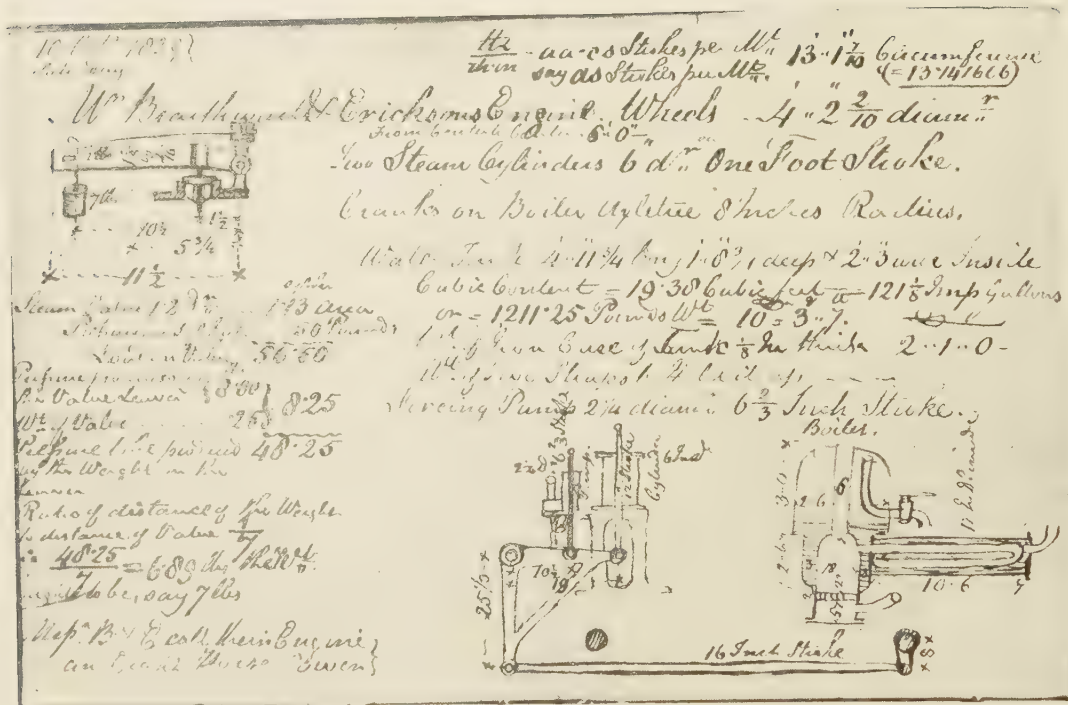
∴ 1127—42 = 1085 Pounds of Coke consumed for a 70 Mile Journey.

$$\& \frac{1085}{70} = 15.5 \text{ Pounds of Coke consumed per mile.}$$

$$\frac{15.5}{6.7} = 2.31 \text{ lbs. of Coke to take a Ton of goods one Mile.}$$

2 $\frac{1}{2}$ lbs. of coal will make one Pound of coke.

∴ 2.31 × 2.5 = 5.77 Pounds of coal used to make 2.31 Pounds of Coke.



APPENDIX.

Page 29.

The Distance was as follows.

	No. 1	No. 2.
	$\frac{1}{8}$ Mile	$\frac{1}{8}$ Mile
	$1\frac{1}{2}$ Miles full speed	
	$8\frac{3}{4}$ Miles from Liverpool	$10\frac{1}{4}$ Miles from L.
Starting post.	for getting up & taking up the Speed	← for taking up & getting up the speed →
	←	→
		Post end of Journey.

The Time was taken at Starting from the Starting Post and also every time the Engine passed the Posts No. 1 and No. 2, for Ten Trips & at the conclusion of the first Journey the time was taken when the Engine returned to the Starting Post. The Number of trips was fixed at 10 and the distance travelled at full speed was 30 Miles and the Total Journey was 35 Miles.

Pages 30 and 31 record the times of each trip in the morning.

They are repeated later more elaborately.

Page 32 gives the dimensions and capacities of buckets of water supplied to the 'Rocket' en route, amounting to 18.4 at West end, and 15 at East (Mr. Wood's) end.

Page 33 has one of the original 'Ordeal' cards pasted on it, which has been illustrated on page 54.

Pages 34 and 35 consist of the times of the afternoon trips, also given again later.

Page 36 bears a 'Stipulations' card, shown on page 37.

Page 37 a 'Race card,' given on page 38.

Page 38 contains details of the 'Novelty,' reproduced opposite.

APPENDIX.

Page 39. 22 Oct. 1829.

Mr. Ericsson says that 20 cube feet per Mt. is the Quantity of Air at $\frac{1}{4}$ lb. density that the Bellows must blow but, if 15 Cube feet of Air is actually delivered into the fire Place for each Horse Power it will be enough. There are three Copper Tubes in the Horizontal Boiler each $2\frac{3}{4}$ inches diamr inside and $10\frac{1}{2}$ feet long, thro' which the air is forced with a velocity of 50 feet per Second.

2 feet double Stroke $\times$ 67 strokes per Mt = 134 feet Velocity of piston per Mt.

6 in. dr. equal to 28.27 sq. Inch area of Piston $\times$ 25 Pounds effective Pressure per square Inch = 706.85 Pounds load upon the Piston.

$706.8 \times 134 = 94,717.9$ Pounds raised one foot high per Minute.

$\frac{94717.9}{33000} = 2.87$ Horse Power for one Cylinder &

$2.87 \times 2 = 5.74$ Horse Power of Engine at ten Miles per Hour supposing the Steam kept constantly up to 50 Pounds per square Inch on the safety Valve.

But if the effective Pressure per square Inch can only be maintained upon the Steam Pistons at 20 Pounds per Square Inch then the Power of the Engine would be only 4.6 Horse Power.

Pages 40 and 41.

10 Oct. 1829 (Saturday) Messrs. Braithwait and Erickson's Engine.

Boiler End with $8\frac{1}{4}$ In. water in Tank	1 ,, 13 ,, 2 ,, 0
Bellows End do.	1 ,, 14 ,, 1 ,, 0

Total weight of Engine with Tank and 8 in } Water and Boiler filled up to its proper Height }	3 ,, 7 ,, 3 ,, 0
--	------------------

Deduct Water in Tank $4' 11\frac{3}{4}"$ long } $2' 3"$ wide and $8\frac{1}{4}$ in. depth of water }	4 ,, 2 ,, 0
Weight of iron tank	2 ,, 1 ,, 0

0 ,, 6 ,, 3 ,, 0
3 ,, 1 ,, 0 ,, 0

Mem. A Bushel of
Coke heaped is
42 lbs.

APPENDIX.

Mr. B & E's Engine being constructed to carry its own Water and Fuel it has been a subject of much discussion with Mr. Wood and myself as to the most correct and just Method of assigning to it its proper load of Carriages and Goods as no Tender was necessary for their Engine. We have therefore taken Mr. Stephenson's Engine as our datum: The Weight of Mr. Stephenson's Engine with its Water in the Boiler is 85 cwt. and the Weight of the Carriages and goods it took after it was 9 „ 10 „ 3 „ 26 which being within 2 lbs. of 191 cwt. we have taken the usefull weight at 191 cwt. We therefore say if 85:191 of usefull Effect in Mr. Stephenson's Engine Then should 61 of Mr. Braithwait's Engine take 137 cwt. of

Carriages & goods. Viz. $\frac{191 \times 61}{85} = 137$ for the weight of Carriages & goods for Mr. B's Engine.

We weighed the Engine Again after it had got its Tank filled with Water and found it as follows.

[illegible]

APPENDIX.

Pages 42 and 43 are blank.

Pages 44 and 45 consist of a fair copy of the times of the running of the 'Rocket' in the morning of October 8th, and are reproduced opposite.

Pages 46 and 47 give the afternoon runs, and are also reproduced.

[These records are copied in Wood; III edition, pp. 311 and 313].

Page 48.—13th October 1829. Tuesday.

Timothy Hackworth's Engine				Ton. cwt. qr. lb.	
Engine with water in the Boiler				4	15 2 0
Tender	1	13	2 24	3 Times	
Water	1	6	3 4	3	6 3 0
Coke	0	6	1 0	14	6 2 0
Waggon	No. 1	3	14 0 0	19	2 0 0
Do.	No. 2	3	14 0 0	Total Mass in Motion	
Do.	No. 3	3	11 3 0		
Load		14	6 2 0		

N.B. The wheels of this Engine all stood upon the Plate of the Weighing Machine, and it was in consequence weighed at once.

Carriages & Goods }
or usefull Weight } 10 19 3 0

At 0 55 0 The Engine having come up with the Plug burned out and only 8 Inches of Water remaining in the Cask, The Plug was put in again and the fire lighted, the cask filled at 1.30 and the Steam was got up again at 2.15 but the forcing Pump having gone wrong again, the further prosecution of the Experiment was abandoned.

[Note. In the 'Stipulations' it was laid down that the Company would provide the tender, and it has generally been assumed that the same one was used for the 'Rocket' and 'Sans Pareil.' It rather looks as if there were two, because the unloaded weight of the 'Rocket's' tender was given by Rastrick as 1 ton 12 cwt. 0 qrs. 22lb., or 1½ cwt. less than the figure above; which seems too large a difference for an error in weighing. Owing to the greater weight, the 'useful load' of this engine was 19 cwt. more than that of the 'Rocket.']

APPENDIX.

Oct. 1029. Garden Board at Starting 8.3.2 of Coke & 300 Gallons of Water.

Lighted the Fire 9.37.0 } H m " H m "

Steam up 10.34.0 } 0.57.0 Time of getting up the Steam

Started 10.36.50 } 0.2.50 Time taken up, before Starting

First Experiment

Table of the Time Occupied each Trip & the Time of going 30 Miles at full Speed and Pistons in Steady and Slipping

Observations	No. of Trips	Time in getting up & Stepping the Fire	Time in getting up & Stepping the Fire	Time in getting up & Stepping the Fire	Time in getting up & Stepping the Fire	Time in getting up & Stepping the Fire	Time in getting up & Stepping the Fire	Observations
Started 10.36.50		10.38.25	0.7.35	10.45.50	0.2.15			
Slipped to 10.42.50	1	10.54.50	0.6.48	11.01.38	0.4.35			Greased the Pistons.
	2	11.10.42	0.9.22	11.20.04	0.2.45			
	3	11.21.10	0.8.50	11.30.00	0.2.20			
	4	11.39.50	0.8.50	11.48.40	0.2.20			
	5	11.58.10	0.7.35	12.05.45	0.2.27			
	6	12.15.45	0.5.55	12.21.40	0.2.53			
	7	12.35.25	0.5.55	12.41.20	0.2.35			
	8	12.55.30	0.7.35	1.03.05	0.3.14			
	9	1.13.45	0.6.57	1.20.42	0.4.2			Look in 16 In. Gallon of Water
	10	1.17.10	0.5.18	1.22.28	0.2.1			
	11	1.33.35	0.7.55	1.41.30	0.2.1			
	12	1.35.50	0.4.12	1.40.02	0.2.1			
	13	1.47.15	0.5.12	1.52.27	0.2.6			
	14	1.58.34	1.11.47	2.10.21	0.2.14.0			
	15	2.10.21	0.2.14.0	2.12.35	0.2.14.0			
	16	2.12.35	0.2.14.0	2.14.49	0.2.14.0			
	17	2.14.49	0.2.14.0	2.17.03	0.2.14.0			
	18	2.17.03	0.2.14.0	2.19.17	0.2.14.0			
	19	2.19.17	0.2.14.0	2.21.31	0.2.14.0			
	20	2.21.31	0.2.14.0	2.23.45	0.2.14.0			
	21	2.23.45	0.2.14.0	2.25.59	0.2.14.0			
	22	2.25.59	0.2.14.0	2.28.13	0.2.14.0			
	23	2.28.13	0.2.14.0	2.30.27	0.2.14.0			
	24	2.30.27	0.2.14.0	2.32.41	0.2.14.0			
	25	2.32.41	0.2.14.0	2.34.55	0.2.14.0			
	26	2.34.55	0.2.14.0	2.37.09	0.2.14.0			
	27	2.37.09	0.2.14.0	2.39.23	0.2.14.0			
	28	2.39.23	0.2.14.0	2.41.37	0.2.14.0			
	29	2.41.37	0.2.14.0	2.43.51	0.2.14.0			
	30	2.43.51	0.2.14.0	2.46.05	0.2.14.0			
	31	2.46.05	0.2.14.0	2.48.19	0.2.14.0			
	32	2.48.19	0.2.14.0	2.50.33	0.2.14.0			
	33	2.50.33	0.2.14.0	2.52.47	0.2.14.0			
	34	2.52.47	0.2.14.0	2.55.01	0.2.14.0			
	35	2.55.01	0.2.14.0	2.57.15	0.2.14.0			
	36	2.57.15	0.2.14.0	2.59.29	0.2.14.0			
	37	2.59.29	0.2.14.0	3.01.43	0.2.14.0			
	38	3.01.43	0.2.14.0	3.03.57	0.2.14.0			
	39	3.03.57	0.2.14.0	3.06.11	0.2.14.0			
	40	3.06.11	0.2.14.0	3.08.25	0.2.14.0			
	41	3.08.25	0.2.14.0	3.10.39	0.2.14.0			
	42	3.10.39	0.2.14.0	3.12.53	0.2.14.0			
	43	3.12.53	0.2.14.0	3.15.07	0.2.14.0			
	44	3.15.07	0.2.14.0	3.17.21	0.2.14.0			
	45	3.17.21	0.2.14.0	3.19.35	0.2.14.0			
	46	3.19.35	0.2.14.0	3.21.49	0.2.14.0			
	47	3.21.49	0.2.14.0	3.24.03	0.2.14.0			
	48	3.24.03	0.2.14.0	3.26.17	0.2.14.0			
	49	3.26.17	0.2.14.0	3.28.31	0.2.14.0			
	50	3.28.31	0.2.14.0	3.30.45	0.2.14.0			
	51	3.30.45	0.2.14.0	3.32.59	0.2.14.0			
	52	3.32.59	0.2.14.0	3.35.13	0.2.14.0			
	53	3.35.13	0.2.14.0	3.37.27	0.2.14.0			
	54	3.37.27	0.2.14.0	3.39.41	0.2.14.0			
	55	3.39.41	0.2.14.0	3.41.55	0.2.14.0			
	56	3.41.55	0.2.14.0	3.44.09	0.2.14.0			
	57	3.44.09	0.2.14.0	3.46.23	0.2.14.0			
	58	3.46.23	0.2.14.0	3.48.37	0.2.14.0			
	59	3.48.37	0.2.14.0	3.50.51	0.2.14.0			
	60	3.50.51	0.2.14.0	3.53.05	0.2.14.0			
	61	3.53.05	0.2.14.0	3.55.19	0.2.14.0			
	62	3.55.19	0.2.14.0	3.57.33	0.2.14.0			
	63	3.57.33	0.2.14.0	3.59.47	0.2.14.0			
	64	3.59.47	0.2.14.0	4.02.01	0.2.14.0			
	65	4.02.01	0.2.14.0	4.04.15	0.2.14.0			
	66	4.04.15	0.2.14.0	4.06.29	0.2.14.0			
	67	4.06.29	0.2.14.0	4.08.43	0.2.14.0			
	68	4.08.43	0.2.14.0	4.10.57	0.2.14.0			
	69	4.10.57	0.2.14.0	4.13.11	0.2.14.0			
	70	4.13.11	0.2.14.0	4.15.25	0.2.14.0			
	71	4.15.25	0.2.14.0	4.17.39	0.2.14.0			
	72	4.17.39	0.2.14.0	4.19.53	0.2.14.0			
	73	4.19.53	0.2.14.0	4.22.07	0.2.14.0			
	74	4.22.07	0.2.14.0	4.24.21	0.2.14.0			
	75	4.24.21	0.2.14.0	4.26.35	0.2.14.0			
	76	4.26.35	0.2.14.0	4.28.49	0.2.14.0			
	77	4.28.49	0.2.14.0	4.31.03	0.2.14.0			
	78	4.31.03	0.2.14.0	4.33.17	0.2.14.0			
	79	4.33.17	0.2.14.0	4.35.31	0.2.14.0			
	80	4.35.31	0.2.14.0	4.37.45	0.2.14.0			
	81	4.37.45	0.2.14.0	4.39.59	0.2.14.0			
	82	4.39.59	0.2.14.0	4.42.13	0.2.14.0			
	83	4.42.13	0.2.14.0	4.44.27	0.2.14.0			
	84	4.44.27	0.2.14.0	4.46.41	0.2.14.0			
	85	4.46.41	0.2.14.0	4.48.55	0.2.14.0			
	86	4.48.55	0.2.14.0	4.51.09	0.2.14.0			
	87	4.51.09	0.2.14.0	4.53.23	0.2.14.0			
	88	4.53.23	0.2.14.0	4.55.37	0.2.14.0			
	89	4.55.37	0.2.14.0	4.57.51	0.2.14.0			
	90	4.57.51	0.2.14.0	5.00.05	0.2.14.0			
	91	5.00.05	0.2.14.0	5.02.19	0.2.14.0			
	92	5.02.19	0.2.14.0	5.04.33	0.2.14.0			
	93	5.04.33	0.2.14.0	5.06.47	0.2.14.0			
	94	5.06.47	0.2.14.0	5.09.01	0.2.14.0			
	95	5.09.01	0.2.14.0	5.11.15	0.2.14.0			
	96	5.11.15	0.2.14.0	5.13.29	0.2.14.0			
	97	5.13.29	0.2.14.0	5.15.43	0.2.14.0			
	98	5.15.43	0.2.14.0	5.17.57	0.2.14.0			
	99	5.17.57	0.2.14.0	5.20.11	0.2.14.0			
	100	5.20.11	0.2.14.0	5.22.25	0.2.14.0			

APPENDIX.

*Stopped at End of first Experiment 2-48-38 } 0-14-34 same in going
 2-3-12 } down from the starting Post
 2-3-12 } returning back
 2-3-12 } to the starting Post again, when 1-0-26 of Gules were taken on
 the engine, the steam having got away of the time till the engine set
 out again in the second experiment.*

Observations	Time of Trains	Time in getting the engine up to the speed of the train	Time in getting the engine up to the speed of the train	Time in getting the engine up to the speed of the train	Time in getting the engine up to the speed of the train	Time in getting the engine up to the speed of the train	Observations
Started 2-3-12	0-1-38	2-4-50	0-6-15	2-11-5	0-2-8		
1 st	0-2-25	2-23-10	0-5-57	2-29-7	0-2-23		
2 nd	0-2-30	2-41-20	0-5-57	2-46-37	0-2-59		
3 rd	0-2-47	2-55-48	0-7-63	3-5-41	0-3-40		
4 th	0-2-41	3-16-8	0-6-47	3-9-21			
Took in 1-0-2 of Gules	0-2-41	3-18-49	0-6-5	3-24-54			
5 th	0-2-48	3-33-36	0-5-51	3-42-17	0-2-32		
6 th	0-2-2	3-52-7	0-6-4	4-0-18	0-2-29		
7 th	0-2-18	4-10-33	0-5-23	4-18-14	0-3-38		
8 th	0-2-13	4-32-24	0-5-25	4-37-49	0-2-18		
9 th	0-1-57	4-46-27	0-3-17	4-52-8	0-2-10		
Stopped 5 0-21-11	0-21-4	1-9-37	0-57-12	0-26-16	0-27-4		
Time consumed in this experiment	2-57-9		2-6-49		0-50-20		

*Steam was as strong as at
 previous Waggons
 out the
 again*

*of this the second Experiment
 was 16 1/2 lbs. per
 sq. in. of water.*

*the 6th we saw
 the 6th we saw*

*7 1/2 lbs. remaining
 in each 6 1/2 lbs. per
 sq. in.*

APPENDIX

Page 49.—13th Oct. 1829.

Coke weighed at starting.

Sack No 1	1 „ 1 „ 25	Imp. Gals.
No 2	1 „ 1 „ 3	Water in Cask at starting . . . 300
No 3	1 „ 0 „ 15	Took in the 7 Trip 8
No 4	1 „ 0 „ 14	Do 8 Trip 8
No 5	1 „ 0 „ 27	
		316

Started with this

quantity	6 „ 1 „ 0	Remained in the Cask	
No 6	1 „ 0 „ 18	at the end of the Time when	
No 7	1 „ 1 „ 13	the Engine came up to	
No 8	1 „ 0 „ 15	have the Water replenished,	42
No 9	1 „ 0 „ 5	when the Plug was burnt	
No 10	1 „ 0 „ 14	out, 8 inches deep,	
	12 „ 0 „ 9	Water consumed for	
		27½ miles	274

Remained at the		
End of the 8th		
Trip when the	0 „ 3 „ 0	And $\frac{274 \times 35}{27.5} = 348$ Imp. Gallons
Engine came up		
with the lead Plug		of Water required for 35 Mile
burnt out, about		Journey.

Consumed in go-	
ing 8 Trips, except	11 „ 1 „ 9
about ½ Mile	

equal to 27½ Miles with

$$1269 \text{ lbs of Coke \& } \frac{1269 \times 35}{27.5} = 1615 \text{ Pounds}$$

of Coke would have been required for 35
Mile Journey.

APPENDIX.

Pages 50 and 51.

13th October 1829, Tuesday.

Timothy Hackworth's Engine having been at Work all Night when we arrived the Water in the Boiler was quite hot. It was therefore useless to attempt to ascertain the quantity of Fuel used in getting up the Steam, or the Time required for that Purpose at this Time. We proposed to do it at another Opportunity & ordered the Engine to start.

[Here follows a table similar to those giving the times of the 'Rocket's' trips; but for eight runs only. It is copied in Wood, IIIrd edition, page 318. The total times taken over the actual $1\frac{1}{2}$ mile course, which had been traversed 15 times when the breakdown occurred, came to 1 hour 37 minutes 16 seconds. The average speed, which was 13.87 miles an hour, was practically the same as that of the 'Rocket' down to that point; the times of the latter for the same distance coming to 1 hour 45 minutes 24 seconds in the morning, and 1 h. 37 m. 31 sec. in the afternoon. The 'Rocket's' average over the whole distance, however, was 16.1, as the speeds improved as time went on, both in the morning and afternoon.]

Page 52.

10th Oct. 1829, Saturday. [It will be noticed that the entries are not always in chronological order. Rastrick had evidently carefully prepared his book beforehand, by ruling pages for the purpose of recording the times of the trips.

The usual table is started for the 'Novelty,' but it only made one double journey.

The time occupied in getting up steam was 54 minutes 40 seconds.] 'Engine passed by Post No. 1 [i.e. on the return journey] the feed pipe being burst & water came out from the forcing pump in consequence of the Engine man having shut the cock between the forcing Pump and the Boiler.

No further Experiment could be made with the Engine this Day as to completing the Task.'

[It did, however, make some trips in the afternoon with passengers, at 30 miles an hour, and became the popular favourite].

APPENDIX.

Page 53.

14th Oct. 1829, Wednesday.

Messrs. Braithwaite & Ericsson's Engine having the Boiler all in pieces when we arrived this morning and as all the joints were to be

made which took till 0 ^H 23 ^M 15" before the Boiler could be filled and the Fire lighted. The Steam was up at 1 ^H 15 ^M 15" which made the time of getting up the Steam 0 ^H 52 ^M 0, the Fuel for getting up the Steam was about 26 Pounds of Coke and the Engine went down and took in Water and started at 1 ^H 25 ^M 40.

[Here begins another table, but only for three trips].

Boiler Joint blew out and stopped the Engine just above the Bridge at 2 ^H 1 ^M 45. And in about half an Hour after Mr. Ericsson came up to me and stated he had withdrawn his Engine as to any further Contest for the 500 Pounds.

Pages 54 and 55, dated 19th, 23rd and 24th November 1829, contain very elaborate details of some experiments 'tried with a Rail Road Carriage taken promiscuously from a Train of Carriages at Shutt End Rail Road upon the lower part of the Incline Plane & which had not been Oiled, by allowing it to descend the Incline Plane with its own Weight & Weight of the Loading (which was Bricks).'

[The degree of inclination was 1 in 30. The speed attained was about 20 miles an hour. According to his calculations, the resistance on the first two days, which were calm, was from 8 to 12 lb. per ton. On the third day there were gusts of wind coming on the side which increased the resistance to from 13¼ to nearly 16 lb. per ton; but he does not give the speeds on that day.

An interesting feature of the carriage (which of course was a truck) was that one wheel was fixed and the other loose, on the axle].

Pages 56 and 57 (13th March 1830) contain a detailed estimate for 'Dock at West Bank Quay' and for a railway (the St. Helens and Runcorn Gap), the total amount being £90,040. This estimate was evidently superseded by another given later on.

APPENDIX.

Pages 58 and 59. 2nd Nov. 1829.

Mr. Robt. Stephenson's Engine.

The gross Weight which this Engine took after it together with the weight of the Engine itself was 17 Tons now if we take the friction to be twelve and one half Pounds for a Ton then $17 \times 12\frac{1}{2} = 212.5$ Pounds the friction of the Mass in Motion and as ten Miles per Hour is equal to 880 feet per Minute $212.5 \times 880 = 187,000$ Pounds raised one foot

high per mt. and $\frac{187,000}{33,000} = 5.66$ Horse Powers required for moving the

Load ten Miles per Hour.

7th Nov. We however find that the Engine when going ten Miles per hour with an effective Pressure of 20 Pounds per Square Inch on the Steam Piston is a Ten Horse Power now a ten Horse Power is equal to 330,000 Pounds raised one foot high per Minute which divided by 880 feet the Velocity per Minute at ten Miles per Hour gives 375 Pounds for the Power applicable to overcoming the Friction and Resistance of the whole Mass that ought to be moved by the Engine at that Velocity.

On a level Plane with Carriages of the customary construction used on the Rail Roads in the North of England, in their average working condition we find that the Friction and Resistance requires a Power of 12.5 Pounds for every Ton Weight of Carriages and Loading.

Taking this as our Datum and dividing 375 Pounds the Power of a Ten Horse Engine at ten Miles per Hour by 12.5 we shall have 30 for the Tons the weight of the Whole Mass that the Engine ought to have taken at that Velocity, from which if we deduct 4.25 being the weight of the Engine it leaves 25.75 Tons which the Engine should have taken after it, which is Six times the weight of this Engine.

Pages 60 and 61. 7th Nov. 1829.

Mr. Geo. Stephenson Informed me that with the Improved Carriages which were drawn by the Engine he had found from Experiments that the Friction and Resistance of each Ton of Carriages and Lading was something under 8 Pounds.

The Locomotives that have been in use some time on the Rail Roads at Stockton & Darlington and at Killingworth the Axletrees are 4 Inches

APPENDIX.

in diameter and the wheels are four feet diameter, this is in a Ratio of 12 to 1 which brings the Friction and Resistance of the Locomotive Engine upon the Rail Road to very nearly the same proportion as the Carriages & Lading viz. 12.5 Pounds to a Ton.

In Mr. Robt. Stephenson's Engine the diameter of the Axletree is 3.25 Inches and the Wheels are 4' 8½" or 56.5 Inches diamr. this gives

a Ratio of $\frac{56.25}{3.25}$ 17.38 to 1, and as the Friction and Resistance will

be reduced in an Inverse Proportion to these Ratios then shall we have
12 Ratio $\times$ 12.5 Pounds

 8.63 Pounds for the Friction & Resistance of each
17.38 Ratio

Ton Weight of the Improved Locomotive Engine, but from the better Method of Oiling the Shafts we may take the Friction of the Whole Mass of Improved Carriages & Engine at 8 Pounds per Ton.

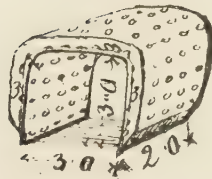
Pages 62 and 63. 7th Nov. 1829.

According to this Statement we should divide 375 Pounds the Power of a Ten Horse Engine at ten Miles per Hour by 8 Pounds, the friction & resistance of a Ton—and we shall have 46.875 Tons for the gross Weight the Engine ought to move at ten Miles per hour—and if from this we deduct the weight of the Engine (4.25) we shall have remaining 42.625 Tons for the Weight which the Engine ought to have taken after it supposing the Friction and resistance is really reduced to 8 Pounds per Ton. Now this is ten Times the Weight of the Engine. I am therefore completely at a Loss to comprehend the Reasons which governed the Directors when they assigned three times the Weight of the Locomotive Engines as the Load which they were to draw after them at a Velocity of ten Miles per Hour—as the work to be done by each Engine, in competing for the prize of 500 Pounds.

It is quite clear that the Weight of the Engines is no criterion whatever of their Power but as three Times their Weight was to be their Load as determined on in the Original Conditions & Stipulations issued to the Public—I considered that we had no power to make any alterations in that respect, and the Ordeal we determined on was merely to put the Engines to the best Proof under these Circumstances.

Pages 64 to 71.

The Rocket has a small Boiler of the figure and dimentions annexed in the Margin, which is constantly kept full of Water this serves for the



Fire Place, the Grate being three feet wide and two feet long, with an area of six feet square, which gives $6/10$ of a square foot of firegrate for each horse Power. The surface of this Boiler exposed to the action of the fire is 18 square feet. It is made of Copper and the flat sides are strengthened by distance Pieces and Rivetts at every three Inches, in each direction. by this means a large fire surface is obtained and a great strength is given to the Boiler, the principal objection to this construction is

the difficulty of getting at the inside to clean it out. The Sediment from the Water will mostly settle to the Bottom into the narrow part where it is rivetted together, but the Scurf or calcarious encrustation will affix itself to all parts of the Inside of the Boiler.

It is proposed to clear out the sediment by making a small Hole on each side towards the Bottom to get the hand in, but as the distance between the Sides of the Boiler is only three Inches, and as there are so many distance pieces in the way, the withdrawing of the Sediment will be a tedious and difficult operation and the Scurf cannot be effectually scaled from off the inside of the Boiler, without taking it to pieces. How often this may require to be done must depend entirely on the nature of the Water, with which the Boiler is fed and can only be learned from experience.

The Body of the Great Boiler is Cylindrical three feet four inches in diameter and Six feet long, through this Boiler in direction of its axis, there go twentyfive Copper Tubes 3 inches in diamr. which are fixed into the Boiler at each End, in such a way that the highest Row is about three Inches below the surface of the Water when the Boiler has its complement of Water in it.

The Caloric and heated Air from the Fire Place and small Boiler

APPENDIX.

passes through these Tubes into the Chimney which is enlarged at its Bottom to embrace the whole of the five and twenty Copper Tubes.

The Chimney is fifteen Inches in diameter at the upper Part of it which is fifteen feet high above the Rail Road.

The twenty five Copper Tubes present a fire surface of $117\frac{3}{4}$ square Feet, if to this we added the 18 feet the fire Surface of the small Boiler, It will give $(18 + 17\frac{3}{4}) 135\frac{3}{4}$ Square feet of Surface exposed to the Action of the Heat from the Fire and estimating this Engine as a ten Horse Power there will be $13\frac{1}{2}$ Square feet fire Surface for each Horse Power.

The area of the 25 Copper Tubes of 3 inches diameter is just equal to the area of the 15 In. Chimney, by this means there will be an equally rapid current through the Copper Tubes as up the Chimney.

The diameter of the Steam Cylinder of the Rocket being 8 inches the Area will be 50.25 Square Inches and the length of the Stroke being 16.5 Inches then $50.25 \times 16.5 = 829.128$ Cubic Inches of Steam of each Cylinder full of Steam, but as there is a space for Clear both top and Bottom of about $\frac{3}{4}$ of an Inch each and the Steam that must fill up the Passages and Side pipe—this will require about $\frac{1}{8}$ th more than the Quantity Calculated from the Length of the Stroke and the Area of the Cylinder.

$$\text{Therefore } 829.125 + \frac{829.125}{8} = 829.125 + 103.640 = 932.765 \text{ Cubic}$$

Inches of Steam used each Cylinder full & $932.765 \times 2 = 1,865.53$ Cubic Inches of Steam used each Stroke, and at $59\frac{1}{2}$ Strokes per Minute we shall have $(1,865.53 \times 59\frac{1}{2}) = 110,999.035$ Cubic Inches of Steam used by each Cylinder per Mt. And as there are two Cylinders there will be 221,998.07 Cubic Inches of Steam used each Mt. by this Engine which with this Steam will go ten Miles and will be equal to ten Horses Power this is equal to 128.47 Cubic Feet of Steam & 12.847 Cubic feet of Steam for each Horse per Minute—the Temperature whereof in the Boiler is 298° and the Elasticity 50 pounds per Square Inch stronger than the Atmosphere.

Note. The temperature corresponding to 50 lb. per sq. inch is 249° F. The stroke should be 17 inches, not $16\frac{1}{2}$.

APPENDIX.

Pages 72 and 73.—

2nd Feb. 1830.

Robt. Daglish's Acct. of The Results of an Experiment made with the Novelty Steam Engine on the 26 Jan. 1830.

Viz. Load $28\frac{1}{2}$ Tons (Passengers included) steam up, 6 h. 16 m. or 6.26 hours.

Coke consumed during that time	lbs. 526	} lbs. 588 = $5\frac{1}{4}$ cwt.
Steam got up in 32 Mts. with (Coke)	62	

$960\frac{1}{2}$ Tons drawn during the Experiments.

	Tons				Tons
Viz.	$28\frac{1}{2}$	carried	30.813	Miles	878.17
	7.5	do	3.224	„	24.18
	17.5	do	3.3205	„	58.11
					960.46 Tons
					Carried one Mile.

The Blowing Apparatus being constantly in Action the average consumption of Coke was 84 lbs. per Hour, or nearly so, viz: $526 \div 6.26 = 84$ lbs.

The average Speed of the Engine was 8.05 Miles per Hour, with a Load of 28.5 Tons.

Viz. $28.5 \times 8.05 = 229\frac{1}{3}$ Tons carried one Mile with 84 lbs. of Coke, which according to the Price of Coke the Goods carried to Manchester from Liverpool and visa versa will not cost 1d per Ton for the whole distance, you will percieve the Engine carried nearly 10 times its own Weight with the adhesion of only two Wheels which is certainly something extraordinary, though I am well aware it will not do it all seasons of the Year.

Orrell Cottage	} R.D.
Nr. Wigan	

[Note. The above experiment is described in Wood, III edition, p. 516].

Pages 74 and 75 each contain a geometrical problem.

APPENDIX.

Pages 76 to 81 contain the following calculations relating to the 'Novelty' and other engines, which are all in code, but have been converted here into figures. The references to other pages have never been filled in.
20th Feb. 1830.

Mr. Erickson maintains that his Engine will work to an effective pressure of 38 Pounds per square Inch upon the Steam Pistons of his Engine, let us calculate what the Power of the Engine ought to be at 10 Miles per Hour.

It has been calculated at fol. that 67 Strokes per Minute or 134 feet velocity of the Pistons per Minute would be 10 Miles per Hour, and the area of the Piston being 28.27 sq. Inches.

$28.27 \times 38 = 1074.26$ Pounds pressure per square Inch¹ on each Steam Piston.

$1074.26 \times 134 = 143,950$ Pounds raised one foot mechanic Power of one Piston or Cylinder.

$$\frac{143,950}{33,000} = 4.36 \text{ Horse Powers of one Cylinder at 10 Miles per Hour}$$

& $4.36 \times 2 = 8.72$ Horse Powers of the Engine at 10 Miles per Hour.

Mr. Erickson says his Engine is an eight Horse Power at 10 Miles per Hour, this would give 34.85 Pounds per square Inch for the Effective Pressure of the Steam on the Piston.

In the Experiment at fol. it appears that this Engine took a load of 28.5 Tons after it at 8 Miles per Hour, now at 8 Miles per Hour this Engine would be a $\left[\frac{8 \times 8}{10} \right]$ 6.4 Horse Power, a horse Power at 8 Miles per Hour is equal to 46.875 Pounds, and $46.875 \times 6.4 = 300$ Pounds the Power of the Engine at 8 Miles per Hour, taking the friction of the Engine Carriage at 10 Pounds per Ton, then 4 Tons the Weight of the Engine will require 40 Pounds and $300 - 40 = 260$ Pounds the Power of the Engine applied to the load of 28.5 Tons.

$$\therefore \frac{260}{28.5} = 9.526 \text{ Pounds the friction per Ton on the Carriages.}$$

These were Mr. Winan's Carriages² with 20 Inch Wheels as the Carriages were drawn each way along the Road the resistance of the Air

¹ The words 'per square Inch' should of course have been omitted.

² Anti-friction bearings.

APPENDIX.

would be neutralized,³ or the absolute effect would be the same as if the Carriages had been drawn through a still and calm atmosphere. as I am not informed of the surface of the Carriages opposed to the Air in direction of the Road I have no means of determining the amount of the Resistance per Ton from this Cause.

I understand the Rails were swept & kept clean during the trial so that we may consider the experiment as made under the most favourable circumstances.

My calculation of the Power of this Engine see fol. only makes it equal to 5.75 Horse Powers at 10 Miles per Hour this would be only $\left[\frac{5.75 \times 8}{10} \right]$, 4.6 horse Powers at 8 Miles per Hour.

$$\frac{46.875 \times 4.6 - 40}{28.5} = \frac{215.625 - 40}{28.5} = \frac{175.625}{28.5} = 6.161 \text{ Pounds}$$

for the Friction of a Ton which is less than I should suppose these Carriages were capable of

It appears there was some question whether the Steam in the Boiler was kept up to more than 50 Pounds per square Inch and it is even said it was maintained at 70—if so, it would give out a greater proportional Friction for the Carriages.

According to the foregoing Calculations Mr. Erickson must work to an effective Pressure of 35 Pounds per Square Inch on the Steam Piston, let us see what Mr. Stephenson's Rocket Engine would be at the same Pressure.

In fol. the area of the Steam Piston is 50.25 sq. Inches. then $50.25 \times 35 = 1758.75$ Pounds effective Pressure on the Steam Piston; and as the Velocity of the Steam Piston is 163.625 feet per Minute $\frac{1758.75 \times 163.625}{33,000} = \frac{287,775.46875}{33,000} = 8.72$ Horse Powers

for one Cylinder and $8.72 \times 2 = 17.44$ Horse Powers say 17.5 Horse Power of the Engine at 10 Miles per Hour.

³ He means resistance of the wind; even so, the statement is not correct.

APPENDIX.

The last Engine Mr. Stephenson tried was called the Wildfire and this had 90 Copper tubes each 2 inches in diameter in the boiler the Cylinders were 10 Inches in diamr. and were laid exactly horizontal in all other respects this Engine was the same as the Rocket.

This is a very interesting reference, as until the unexpected discovery of an early ledger of Robert Stephenson and Co's. in 1928, which also mentions it, the name 'Wildfire' was quite unknown to locomotive historians. It must have been either the one afterwards called 'Meteor,' or the 'Arrow,' probably the latter. The precise number of tubes in these engines was 88, and, of course, the cylinders were not *exactly* horizontal, though nearly so.

Now presuming that Mr. Stephenson had made the Boiler of sufficient Power to maintain the Steam in the Boiler at 50 Pounds per square Inch and to supply the Cylinders with the full quantity of steam when the Engine was going 10 Miles per hour and as the Power of Engines under similar circumstances is as the square of the diamr. of their Cylinders

$\frac{17.5 \times 100}{64}$

then $\frac{17.5 \times 100}{64} = 27.34$ Horse Powers say $27\frac{1}{3}$ Horse Powers for the Power of the Wildfire.

I understand that this Engine travelled at 11 Miles per Hour with a load of 28.5 Tons after it. I have not been told the Weight of this Engine, but I will take it at 4 tons 15 cwt. and the Tender at 3 tons 5 cwt. making together 8 Tons.

Now a Horse Power at 11 Miles per hour is equal to 34 Pounds therefore $34 \times 27\frac{1}{3} = 929.33$ Power of the Engine at 11 Miles per hour $929.33 - 100$ Friction of Engine and Tender = 829.33 and

$\frac{829.33}{28.5}$

= 29 Pounds the friction of a Ton on the Carriages which is

more than double the friction of the Worst Carriages I ever tried. I should rather presume the engine was not supplied with Steam neither could the effective pressure be 35 Pounds per Square Inch on the Steam Piston. If we take the Effective Pressure at 25 Pounds per square Inch then would the Rocket be a 12.5 Horse Power and of course the Wildfire would be a $\left[\frac{12.5 \times 100}{64} \right]$, 19.5 Horse Power, at this rate (19.5×34) , 663 Pounds would be the Power of this Engine at 11 Miles per hour, and

APPENDIX.

$\frac{663-100}{28.5}$, 19.75 Pounds would be the Friction per Ton for the Carriages.

Again if we take the effective Pressure at only 20 Pounds per square inch on the steam Pistons then would the Rocket be a 10 horse Power and the Wildfire a $\left[\frac{10 \times 100}{64} \right]$, 15.6 Horse Power at this Rate (15.6 $\times$ 34), 530.4 Pounds would be the Power of this Engine at 11 Miles per hour and $\left[\frac{530.4 - 100}{28.5} \right]$, 15 Pounds would be the friction of the Carriages per Ton.

Now either this Engine is enormously deficient in Power or the Carriages are the Very Worst I ever met with.

Pages 88 and 89 (not dated).

St. Helens Railway.

An Estimate of the Expenxe of forming the proposed Railway and the Branches thereof from St. Helens to Runcorn Gap and also of constructing the West Dock at the termination thereof at West Bank all in the Parish of Prescott and County of Palatine of Lancaster.

Iron Rails & Chairs	...	...	...	16,830
Stone Blocks Laying & forming Road	...	...	...	20,430
Gates Fences & Drains	...	...	...	6,770
Land	...	...	...	5,250
Earth Work	...	...	...	11,500
Masonry	...	...	...	9,230
Buildings & Machinery	...	...	...	7,500
Dock				
Masonry	...	...	20,800	} 31,620
Earthwork	...	...	7,820	
Carpentry Timber & Paving	...	...	2,250	
Land	...	...	750	
Contingencies	...	...		10,900
				119,980

[Note. He has made a mistake in addition; it should be 120,030.]

APPENDIX.

Page 90 contains some interesting notes on the 'Novelty,' in pencil:

19th Augt. 1833 at St. Helens.



Novelty Engine rebuilt by Mr. Daglish on the St. Helens Railway with 58 Brass Tubes ea. $1\frac{3}{8}$ dia.

Fire Grate . . . 2' 6" dr.

Wheels 4 ft. dr. 6' 9" from Centre to Centre. 2. 6 Inch Cylinders each 16 Inches Stroke.

This Engine brings up a rise of one in 330 — 12 Empty Waggon's each weighing 2 Tons at the Rate of 15 Miles per Hour.

Forcing Pump $2\frac{1}{4}$ In. Dr. — 16 Inch Stroke.

Page 91 has the following fragmentary notes in pencil:

Clarence	2	—	11" Cy.	5f. 6 luggage carriage for Bolton.
Sun	2	—	11" Cy.	} 18 loaded carriages.
Sampson	2	—	14" Dr.		4½ f.
24 Carriages				

Thos. Millbourn took up Rain Hill Incline with the Experiment 10 Loaded Carriages in $7\frac{1}{2}$ Minutes & returned & took up 9 more in

[Note. The 'Clarence' was a Bolton engine, built by Bury. The others were L. and M.R.]

Pages 92 and 93 are blank.

Pages 94 to 98 are occupied with details of heating apparatus for Wordsley Church (which is near Stourbridge).

APPENDIX.

Page 99—blank.

Pages 100 and 101.

Copy of Valuation of 3 Locomotive Engines three Tenders and other Materials belonging to the Warrington and Newton Railway Company to be taken by Messrs. Tayleur and Stephenson.

Engine No. 1	“ The Warrington ” (new 1 June 1831)	250	0	0
Do No. 2	“ The Newton ” (new 1 Sept. 1831)	450	0	0
Do No. 3	“ The Achilles ” (new 9 Dec. 1831)	450	0	0
	3 Tenders	180	0	0
	Portable forcing Pump	8	0	0
	One set New Excentrics	10	0	0
	One old lately repaired	7	0	0
	6 new Copper Tubes 84 lbs at 1s.	4	4	0
	A pair of spare Engine Wheels small size	22	0	0
	One large odd Spare Wheel	8	0	0
		1389	4	0

Signed John Dixon, Sept 4 1834.

Pages 102 to 107 contain pencil notes describing the exact state of repair of the above engines. There is nothing of special interest, except that the cylinders of the ‘ Achilles ’ were 11 by 16.

The rest of the book, consisting of about 40 more pages, is blank, except that at the end there is a detailed account of the cost of an ‘ Engineers’ Dinner,’ dated 10th October 1829; which is the one held in connexion with the Competition, mentioned in the ‘ Life of John Ericsson ’ as having been given to the directors and officers of the railway and the competitors. Sixty one sat down, of whom seventeen were guests, the total cost being £97 ,, 16 ,, 7. The account is headed ‘ To William Lynn.’ He was the proprietor of the Waterloo Hotel, Liverpool, where the dinner was held. An account of it appeared in the *Liverpool Albion* for October 12th, which said ‘ Mr. Rastrick was in the Chair, supported by Mr. Wood and Mr. Hartley as Vice-Chairmen.’

Thus ends this historic document—on a note of conviviality.

INDEX.

Names in Italics are those of Engines.

- Accidents 87, 105
 Ackermann prints 67, 75, 127-134; Pls. III-XIII, XVI-XVIII, XX, XXI, XXIV
 Acts of Parliament 14, 15, 143
Agenoria 36, 51
 Allan, Alexander 121
 Allcard, William 20, 21
Apollo 126
Arrow 82
Atlas 86, 99
 Baird's lithographs 101, 109, 138
 Baltimore & Ohio Ry. VI
 Banks, J. 113
 Benson's lithograph 138
 Birmingham & Liverpool Ry. 21, 120
 Bolton & Leigh Ry ... 21, 32, 48, 71, 86, 105, 114-116
 Booth, Henry 39, 41, 57
 — 'Memoir of' 39, 149
 'Boulton's Siding, The Chronicles of,' 97, 99
 Bourne, Bartley & Co. 119
 Bournes & Robinson 106, 107
 Braithwaite, John 44, 102
 Brandreth, T. S. 14, 51
 Brown, William 38, 39
 Brunton & Shields Ry. 36
 Buddicom, William 27, 73, 122
 Buffers 65
 Burstall, Timothy 49, 50, 57
 Bury, Edward 39, 86, 103, 106
 — & Co. 111
Caledonian 89, 90, 105, 145
 Canals 2-4
 Canterbury & Whitstable Ry. VI, 20
 Carriages 66-68, 131; Pls. XVIII, XIX
 'Century of Locomotive Building, A' ... VI, 20n, 32n, 64, 86, 91n, 112, 115, 150
 Chat Moss 20, 22, 130; Pl. III
 Chester & Crewe Ry. 120, 125
 Chintz, illustration on, 139, 158
Clarence 106, 116, 187
 Clayton's views 137; Pls. XIII, XIV
 Coal, experiments with 86, 87
Columbine 125
 Colyer's lithographs 28, 34, 113, 145
Condor 99
 'Container' system 68
 Crane's lithographs ... 24, 27, 67, 136, 138; Pl. XXIII
 'Creevy Papers, The' 64
 Crewe Works 122
 Crook & Dean 115
 Crown St. station 28
 'Cyclopede' 50, 51, 53
 Dewrance, John 74, 97, 99
 Directors (L. & M.R.) 14
 Dividends 71, 145
 Dixon, John 20, 21, 33, 73
Doctor Dalton 125
 Dodds, Isaac 105, 106
Dreadnought 103
 Dublin & Kingstown Ry. ... 90, 94, 95, 106
 Dundonald, Lord 78
Eden 126
 Edgehill 28, 122, 129, 134; Pls. IX, XXI
Engineer, The ... 78, 82, 110, 111, 121, 122, 151
 Engineers' Dinner 188
 Ericsson, John 44, 45, 102, 103
 — 'Life of' 149, 150
 Estimates (L.&M.R.) 11
Experiment 90, 91
 Fares 68, 69
 Fenton, Murray & Jackson 110
 Fireboxes ... 78, 81, 82, 86, 87, 99, 107, 180
 Forrester & Co. 94, 112, 126
 Fuel Consumption 99, 100
Fury 75, 87
 Fyfe 74
 Galloway, Bowman & Glasgow 89, 111
 Gauge 16
 Gauge Commissioners' Report 72n, 73, 99n, 119, 121n, 125
 Goblet, glass 156
Goliath 85, 86
 Gooch, Thomas 20, 21
 Gradients (L & M.R.) 165
 Grand Junction Ry. 21, 71, 91, 120-126

INDEX.—*Continued.*

- Gray, John 74, 100
Gray, Thomas 3
‘ Great Liverpool Railway ’ 71
Gurney, Goldsworthy 39, 102
Hackworth, Timothy 46, 47
— ‘ and the Locomotive ’ 56n, 150
Hahr, O. W. 39
Haigh Foundry 112, 119, 125
Hall, Samuel 87
Handkerchiefs 157, 158
Hargreaves, John 106, 107, 114
Hargreaves, William 113
Havell’s aquatint 137, 156
Hawthorn, R. & W. 112
Hebert, Luke 45n, 49
Hick & Sons 113
Horseley Iron Co. 105, 106
Huskisson, William 61-63
‘ Intersection ’ bridge ... 116, 133; Pl. XXIV
‘ Intimate Story of the Origin of Railways ’ 20
Irwell bridge 28
James, William 3, 7-10
Jessop, William 3
Jones, Turner & Evans 108, 126
Kemble, Fanny 64
Kendrick’s Cross 26
Kennedy, John 51, 52
Lancashire Witch 31, 32, 114
Lap 100
Lawrence, Charles 14
Lea Green 52
Legh, John 106
Leigh & Kenyon Ry. 114
Leopard 96
Lime St. station 71, 134; Pl. XXI
Lion 96
Liver 86, 87, 105
Liverpool, its history 1
 stations 28, 71, 131; Pls. IX, XVII, XXI
— tunnel 19, 24, 25, 28, 129; Pl. V.
Liverpool 103-105, 116
‘ Liverpool & Manchester Ry., Account
 of the ’ 11, 53, 141, 142, 149
— ‘ An accurate Description of the ’ 29, 66n,
 82, 137, 142
— Travelling on the ’ 109; Pl. XX.
Locke, Joseph 19, 20, 121
— ‘ Life of ’ 20, 25n, 120n, 148
Locomotive, The 96n, 99n, 119
‘ Locomotives & Stationary Engines ’ ... 99
Locomotives, lists of, on Bolton Ry 115
— at Collieries 5, 35
— on Grand Junction Ry. 123, 124
— on L. & M.R. 75-77
— on North Union Ry. 118
— on Warrington & Newton Ry. 117
‘ Locomotive Engines and Railways, A
 Practical Treatise on ’ 146, 147
London & Birmingham Ry. 71, 90
London & North Western Ry. 71, 119
Lune 126
Manchester, its history 1, 2
— entrance to 13, 15, 130; Pl. XI
— station at 30
Manchester 89
Manchester & Birmingham Ry. 71
Mather, Dixon & Co. 71, 107, 112
‘ Matthew Murray, Pioneer Engineer ’ ... 110
Mechanics’ Magazine ... 38, 39, 43, 44, 49,
 53, 55, 91n, 141
Medals 152-154; Pls. XXV, XXVI
Melling, John 74, 101
Melling & Co. 125
‘ Memorials of a Quiet Life ’ 65
Mercury 86
Meteor 82
Moorish Arch ... 28, 131; Pls. VIII, XXVIII
Music, piece of 158
Nasmyth, James 78, 81
Nelson 115
Newton Bridge 26, 27
‘ North-Eastern Ry., History of the ’ Vin, 8n
North Star 78, 82
Northumbrian 78, 80-82, 136
North Union Ry. 20, 45, 71, 118, 119
‘ Notes and Queries ’ 64
Novelty ... 43-46, 53-57, 117, 150, 165, 168,
 170, 171, 176, 177, 182-184, 187
Olive Mount 23, 24, 129, 130; Pl. IV
‘ Ordeal, the ’ 54, 169
Ostrich 98
Outram, Benjamin 3
Panther 96
Parkside 34, 61, 132; Pl. XVI
Parliamentary proceedings 12, 13, 140
Parr Moss 23
Patentee 91-94, 100
Pease, Edward 6, 7
Peel 86, 116
Peel, Williams & Peel 109

INDEX.—*Continued.*

- Perkins' 'Circulating device' 86
 Permanent way 66
Perseverance 49, 50, 56, 57
 Phipps, Col. Pownoll 65
Phoenix 82, Pl. XXIII
Planet 83-85, 100, 147
Pluto 100
 Pottery 154-156; Pls. XXVII, XXVIII
Prince 125
Prince Albert 126
Prince George 107
Princess 125
 Prospectuses (L. & M.R.) 11-13
Queen Adelaide 102, 117, 157
 'Race Card', The 38, 169
 'Railroads, A Treatise on' ... 41, 50n, 53,
 56n, 144, 172, 182
 'Railway Companion, The' 90, 145
 Railway Foundry 112
 'Railway Pioneers, A Story of' 105
 Railways, the earliest 5
 'Railways of Great Britain and Ireland,
 The' ... 72, 73, 86n, 114, 118, 122, 147
 Rainhill Bridge 25, 26; Pl. VI
 — Competition 33; Ch. VI; Appendix
 Rastrick, J. U. 35, 51
 — his notebook 41, 42, 50, 53, 55; Appendix
 Rennies, the 12, 16
 'Rennie, Sir John, Autobiography of'
 16n, 149
Rocket ... 33, 39-43, 53, 55, 56, 78, 79, 162,
 164, 166, 167, 173, 174, 178-181
Rocket No. II 78; Pl. XIX
 Rothwell & Co. 113
Royal George 36
 Runcorn 2, 4
St. George 118
 St. Helens Ry. ... 20, 45, 103, 116, 117, 186
Samson 86
 Sandars, Joseph 9, 10
 — pamphlet by 10, 140
 Sankey valley 24
 — viaduct 26, 27, 130; Pl. VII
Sans Pareil ... 46-48, 53, 56, 115, 161, 172,
 175, 176
 Screw couplings 39, 65
 Share certificate 15
 Seguin, Marc 94
 Sharp, Roberts & Co. 91
 Shaw's etchings 23, 25, 27, 59, 80, 84, 135, 136
 Shepherd & Todd 112
 Signals 71, 72
Sisyphus 125
 Slave Trade 1
 Smith's lithographs 84, 137, 138
 Smokebox, the first 78
 Smoult's illustrations 137
Soho 109
 Stafford, Marquis of 13, 14
 'Stanhopes' 68n
Star 105, 106
 'State carriage,' the 58, 60
 Stationary Engines 28-30
 'Steam Engine, History and Progress of'
 49, 146
 Stephenson, George 5-9, 16, 17, 57; Pl. I
 'Stephenson, George and Robert, Lives
 of' 7, 16, 18, 42n, 148
 Stephenson, Robert 9, 17, 18, 57; Pl. II
 — 'Life of' 149
 Stephenson, Robert & Co. 110
 Stephenson and Locke's 'Observations'
 36, 141
 'Stipulations and Conditions' 37, 169
 Stockton & Darlington Railway V, 6, 35, 36
 Surveys (L. & M.R.) 9
 Sutton Bank 24, 29, 34, 57
 Swanwick, Frederick 21
Swiftsure 94, 95
 Sylvester's Report 140, 141
 Tablecloth 156
 Tayleur & Co. 107, 111, 116, 125
 Tickets Pl. XXII
 Time-tables 68-70
 'Timothy Hackworth and the Locomo-
 tive' 20, 56n
 Todd, Kitson & Laird 96, 112
 'Tour through England, A' 22
 Trevithick, Francis 122
 Tunnel, the 19, 24, 25, 28, 129; Pl. V
Twin Sisters 32, 37n
 'Two Essays in early Locomotive
 History' 6, 50, 115, 151
 'Two James's and the Two Stephen-
 sons, The' 7-9, 148
Union 115
Utilis 116
Vauxhall 95
Venus 86, 106
Victoria 78, 116

INDEX.—*Continued.*

Vignoles, Charles	12, 18-20, 39, 53	Whiston bank	24, 29, 33, 57
— drawing of Novelty and train ...	57, 138	White Raven	117
— 'Life of'	19n, 149	Wigan Branch Ry.	20, 118
Vulcan Foundry, see Tayleur & Co.		Wight, —	39
Walker, James	35	Wildfire	82, 185, 186
Walker & Co.	125	William IV	102, 103, 117
Walker's and Rastrick's Reports	36, 141	Winans' anti-friction bearings	163, 183
Warehouses	131; Pl. XII	— 'manumotive carriage'	54
Warrington	117	Wood, Nicholas	8, 51, Pl. XV
Warrington & Newton Ry.	117, 188	Woods, Edward	73, 74, 99-101
Water Street bridge	28; Pl. XI	Wordsworth	126
Wellington, Duke of	58, 61, 62		

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